EVALUATION OF BLOOD UTILIZATION PRACTICE IN OBSTETRICS – A PROSPECTIVE STUDY

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ABSTRACT

EVALUATION OF BLOOD UTILIZATION PRACICE IN OBSTETRICS- A PROSPECTIVE STUDY

Background: The optimal blood usage in modern therapeutics avoids transfusion risks and aid better blood inventory management. The maximum blood utilization in the developing country is for the Obstetrics. Frequent requests are made to cross-match units as a precautionary measure for Caesarean Sections in patients with anticipated blood loss, resulting in wastage of health care resources. Hence, studying the current Clinical Transfusion Practice in Obstetrics would ensure the appropriate blood usage in modern health care services.

Aim and Objectives: To assess the Red cell utilization in Obstetrics Transfusion Practice and to assess its appropriate use.

Materials & Methods: The study conducted for one year (August 2014-July 2015) on the Obstetrics in-patients for whom blood transfusion requests were given. The requests were processed and cross-matched as per the hospital transfusion guidelines. The data collected on the clinical and blood transfusion particulars of the patients were analyzed for the Red cell usage according to their diagnosis. Blood utilization indices calculated and compared with the standard cut - off values to know the current red cell transfusion practice. The appropriateness of red cell use was assessed by RCOG guidelines for Blood transfusion in Obstetrics, Green-top guidelines no. 47.

Results: Total Obstetrics in-patients for whom requests for cross- match given-1010. 96% (n=969) of the patients had been transfused with blood components of various combinations. Anemia is the common indication for transfusion (30.1%). A total of 352 Caesarean cases (emergency cases=316, repeat section

cases-142 cases) utilized 505 red cell units. 86.1% of transfused red cell units were for emergency LSCS. C/T Ratio -1.03, Transfusion Probability -96%. Transfusion Index -1.3, Single unit transfusion rate - 61.3%, Whole blood transfusion rate - 6.9% was the outcome of the study. Plasma(497 units used for 88 cases), platelet (191 units used for 34 cases), and cryoprecipitate (26 units used for 3 cases) were issued to 35 cases of APH, 42 cases of PPH, 23 cases of DIC, and 5 cases of HELLP in various combinations. As per RCOG guidelines, 141 patients were inappropriately (28.6%) transfused with RBC units.

Conclusion

The single unit transfusion rate could be kept to a minimum with the optimal correction of anemia during pregnancy. Blood utilization indices were well within normal limits because majority of the blood units (86.1%) transfused were for emergency LSCS. However, inappropriate use of red cell units (28%) can be reduced further by avoiding transfusion in patients with Hb of more than 10 gm% and also in asymptomatic anemic patients with Hb of 8-10 gm%.

Adequate blood inventory always allays Obstetrician's apprehension of blood availability. At the same time, in a developing country like India where demand is always more than its supply, appropriate use of blood components is repeatedly emphasized.

Key Words: cross-match/transfusion ratio(C/T ratio), Transfusion Probability (%T), Transfusion Index (TI), anemia, appropriateness, Hb-hemoglobin.

CONTENTS

LIST OF ABBREVIATIONS

AABB	-	American Association of Blood Banks
ABT	-	Allogenic Blood Transfusion
ACOG	-	American College of Obstetrics and Gynaecology
ANP	-	Atrial Natriuretric Peptide
APH	-	Antepartum Haemorrhage
aPPT	-	activated Partial Thromboplastin Time
ASA	-	American Society of Anaesthesiologists
%T	-	Transfusion Probability
2, 3 DPG	-	2, 3 Di Phospho Glycerate
ANH	-	Acute Normovolemic Hemodilution
APC	-	Activated Protein C
ATP	-	AdenineTri Phosphate
BCSH	-	British Committee for Standards in Haematology
C/T Ratio	-	Cross-match / Transfusion Ratio
CAP	-	College of American Pathologists
cEmOC	-	comprehensive Emergency Obstetric Care
CS	-	Caesarean Section
DIC	-	Disseminated Intravascular Coagulation
DNA	-	De-oxy ribo Nucleic Acid
ECO	-	Enzyme converted ‘O’ cells
EPO	-	Erythropoietin

FFP	-	Fresh Frozen Plasma
Hb	-	Haemoglobin
HBsAg	-	Hepatitis B surface Antigen
HBV	-	Hepatitis B Virus
Hct	-	Hematocrit
HDFN	-	Haemolytic Disease of the Fetus and Newborn
HELLP	-	Hemolysis, Elevated Liver Enzyme, Low Platelet Count
HRQoL	-	Health Related Quality of Life
HTR	-	Haemolytic Transfusion Reaction
IOCS	-	Intra-Operative Cell Salvage
ITP	-	Immune Thrombocytopenic Purpura
LSCS	-	Lower Segment Caesarean Section
MMR	-	Maternal Mortality Rate
MOH	-	Major Obstetric Haemorrhage
MTP	-	Massive Transfusion Protocol
NAT	-	Nucleic Acid Amplification Test
NICE	-	National Institute of Clinical Excellence
NIH	-	National Institute of Health
OH	-	Obstetric Haemorrhage
PAD	-	Preoperative Autologous Deposit
PIH	-	Pregnancy Induced Hypertension
PPH	-	Postpartum Haemorrhage

PRBC	-	Packed Red Blood Cells
PT	-	Prothrombin Time
RBC	-	Red Blood Cells
RCOG	-	Royal College of Obstetricians and Gynaecologists
rFVIIa	-	Recombinant Factor VIIa
Rh	-	Rhesus blood group
SHOT	-	Serious Hazards Of Transfusion
TACO	-	Transfusion Associated Circulatory Overload
TA-GVHD	-	Transfusion Associated Graft versus Host Reaction
TF	-	Tissue Factor
TI	-	Transfusion Index
TRALI	-	Transfusion Associated Lung Injury
TRIM	-	Transfusion Related Immunomodulation
TTI	-	Transfusion Transmitted Disease
U.K.	-	United Kingdom
vWF	-	von Willebrand factor
WB	-	Whole Blood
WBC	-	White Blood Cells
WHO	-	World Health Organization
WOMAN	-	World Maternal Antifibrinolytic Trial
WOMB	-	Well-being of Obstetric patients on Minimal Blood Transfusions

1. INTRODUCTION

The Major Obstetric Hemorrhage (MOH) is the most common cause of maternal mortality worldwide [1]. Blood transfusion therapy is the back bone of Obstetric management. As a failsafe element it rescues patients who are bleeding [2]. **W**orld **H**ealth **O**rganization (WHO) recognizes blood transfusion as one of the eight essential components of cEmOC (**c**omprehensive **Em**ergency **O**bstetric **C**are) to reduce the maternal mortality rate (MMR) [3].

Blood is a scarce human resource but without a substitute, potentially dangerous owing to the immune and nonimmune complications of hemotherapy. Frequent blood requests are given without proper analysis of the real needs, as a "cushion" for either patients being in labor or the patients undergoing Caesarean section in the event of unexpected hemorrhage. Also in many hospitals, the standards concerning the usage of blood for surgical reasons have not been changed for many years. "Transfusion styles" result in waste and inappropriate use of this altruistic resource. The average requirement for a particular procedure is usually based on the subjective anticipation of blood loss rather than on evidence based estimates. It also evolves as a wrong perceptional issue on the part of operating room personnel that the blood bank will be unable to respond to an emergency situations[2].

Over ordering of blood with minimal utilization and unnecessary transfusions have serious implications like increased patient morbidity and mortality , expiry of the unused wasted blood , reduced blood bank inventory ,blood

unavailability in times of the need , technical time wastage, overall workload increase and transfusion cost increase[4].

In recent times, optimal use of blood products has become an integral part of national Hemovigilance system in few countries like Belgium, Ireland, and Netherlands. The economic impact of blood transfusion is rather large, though it plays minor role in the whole process of treating a patient. Thus minimizing unnecessary transfusions conserves the blood components and reduces the healthcare expenditures[5]. .

The audits on clinical transfusion practices have also consistently pointed about the lack in knowledge on prescription, identification or administration of the transfusion recipients [6].

As per the **A**merican **A**ssociation of **B**lood **B**anks (AABB), to monitor the transfusion practices, a system should exist. One such tool of that system is analyzing the blood requisition forms and blood component utilization [7] which ensures the appropriateness of blood usage in modern health care services.

Hence, with this background, this study is designed to know the current transfusion practice in Obstetrics field in the Department of Obstetrics and Gynecology, Government Kilpauk Medical College hospital, Chennai and thereby helping to promote good clinical transfusion practice.

2. AIM

To assess the red cell utilization in Obstetrics transfusion practice.

OBJECTIVES

To study the red cell transfusion requirement in the Obstetric in-patients.

To assess how many of the obstetric patients actually received red cell transfusion.

To analyze the indications and appropriateness of the transfused red cell component.

3. REVIEW OF LITERATURE

3.1 Past, Present and Scanning the Future of Transfusion Medicine

From time immemorial, the vitality of blood is known to mankind. Bathing in blood and drinking it to acquire its vitality were the ancient practices. Bloodletting as self-punishment and as therapeutic modality was also in vogue. The knowledge acquisition by William Harvey in 1628, regarding the composition of blood and its circulation within the body[8] were the small stepping stones but a giant leap for experimental blood transfusion practices.

After a 150 years dark period of dormancy, the blood transfusion research gained momentum following a historic event of first human to human transfusion in 1818 by the British Obstetrician and Physiologist Dr. James Blundell. When he witnessed the dying mother due to Postpartum Hemorrhage (PPH), he helped her out by transfusing the blood from her husband [9]. The concepts that blood transfusion - as a treatment for hemorrhagic shock, blood transfusion within the species and not across the species, and the devices he developed to execute the procedure of blood transfusion, neonatal resuscitation were the monumental contributions from him[8].

The Herculean task to keep the blood in the liquid state during collection and upon transfusion gained momentum during the World War period. It came into fruition with the contributions from many scientists like Braxton Hicks, Lewisohn, Hustin, Weil, Rous and Turner. Mollison developed the preservative solution-ACD, which was the anticoagulant used for the next 30 years [8.]

The landmark discovery of ABO blood groups in 1901 by the Austrian scientist Dr. Karl Landsteiner[8] fetched him the Nobel Prize in 1930. The discovery of Rh and other blood group systems and their genetic basis, the blood cross match procedures, rediscovery of Antiglobulin test by Coomb, Race and Mourant thus made compatible Allogenic Blood Transfusion (ABT) into reality. Hemolytic Disease of the Fetus and Newborn (HDFN) evaluation and development of Anti D vaccination is another milestone in the field of Immunohematology [9].

The further advancements in blood transfusion therapy like using plasma for shock, establishing blood storage centers, blood banks to store refrigerated blood happened due to the knowledge gained from the blood transfusion experiences of the World War field [10].

Blood component therapy came into existence with the advent of plastic bags with the efforts and experiments of Carl Walter. It was another step ahead when the usage of the plastic bags for blood collection was first licensed in1962 but before, they were used for experimental purpose in Korean War [11]. Cytapheresis/Apheresis, one another advancement in this field, aims for the betterment of component therapy, donor safety and blood inventory.

A new standard of care called Patient Blood Management (PBM) which is a multidisciplinary, multimodal, individualized strategy, has been already established in Europe. This strategy developed to reduce the ABT, as there is evidence of both clinical and economical disadvantage of ABT, in managing peri-operative anemia and it advocates the restrictive use of the same[12].

Transfusion Medicine developed in parallel with the advancements in the fields like Immunology, Genetics, Biochemistry, and Laboratory Medicine. It has soared high to establish quality standards for its blood products, donor safety, patient safety, product safety. Automation, Information Technology, usage of Nucleic Acid Amplification Testing (NAT), Leucoreduction, and Irradiation has reduced the potential allogenic transfusion risks to a very minimal level.

In this age of Genomics, we are yet to find an ideal blood substitute .We depend only on the human resource. It is an uphill task to meet growing demand of the safe volunteer blood, due to the changing donor demographics leading to diminished donor pool even in developed countries. Moreover, the small but definite risk of blood transfusion still exists. Emerging infections also threatens the blood safety and the patients' outcome. Hemovigilance for the donor and patient safety is blooming on its way in different parts of the world.

Proteomics and other 'Omics' technology[13] influences the better understanding of blood storage lesion and thus strategies are on its way in development for the purity, potency, identity and quality of blood pharmaceuticals. Enzyme converted 'O' cells (stealth RBCs or ECO cells), hemoglobin based oxygen carriers, stroma free hemoglobin, liposome based hemoglobin, culturing the blood cells are the dreams left for the future reality. The wings of Transfusion Medicine has extended to other areas like Cord Blood Banking, Marrow Stem Cell Registry establishment, Regenerative Medicine, Cell based therapy and so on[8].

The flag is sure to flutter one day over the fort of the Transfusion Medicine, when the event of artificial blood comes in realization and thus completely eliminates the risk of human blood transfusion, as because blood is life!

3.2 Epidemiology of blood transfusion

The global collection of blood units is about 107 millions. Developed countries with 15% of the worlds' population collect 50% of the worlds' blood. Also, the median blood donation rate in the high-income and low-income group are 39 donations / 1000 and 4 donations /1000 respectively. In the developing countries, the demand is high but handicapped with the short fall in its supply. Blood non-availability could contribute to about 25% of maternal mortality and 40% of the mortality in children. The severe childhood anemia due to malaria, Obstetric Hemorrhage, trauma and surgery are the most common list of indications for which blood transfusion is advocated in these countries. Lackritz et al., Bugge et al., Natukunda et al. had documented a 13%, 17%, and 17% of blood utilization rates for the pregnancy related complications respectively in their studies[14].

WHO states that on an average 11 units (6-16 units) is the requirement per hospital bed and accordingly there is shortage of 40%. The usage of 80-85% as the Whole Blood (WB) in clinical transfusion practice contributes to 25% of inappropriate use due to WB, rather than the component usage. International Red Cross estimates that the usage of blood would come down to 30% if appropriately used [15].

3.3 Blood Transfusion vs. Maternal Mortality in the Developing world.

Blood usage in developed countries is for surgical and advanced medical conditions like chemotherapy induced anemia[16] but these countries too contribute to the inappropriate transfusions of about 18-35%[15]. And the scenario in developing world is that the Obstetrics blood usage stands high (37%)[16]. In India, inappropriate utilization of the blood resources is about 30 - 60% [15]. Our country also lacks a National Blood Transfusion Service with the existence of many unregulated fragmented blood transfusion services.

Obstetric Hemorrhage continues and leads the cause for maternal mortality-34% in Africa, 31% in Asia, 21% in Latin America and 13% in the developed countries [16]. The MMR in India is 254 /1, 00,000 live births. As per the Millennium Development Goal, it is set as 100/1, 00,000 live births [17]. In spite of improved Obstetric care than ever before, maternal deaths due to hemorrhage is 26% in sub-Saharan Africa and these are direct consequences due to lack of blood transfusion services. Access to safe blood transfusion could have averted 150,000 maternal deaths each year[18, 19]. But in developed countries, blood is safer than ever before with molecular screening methods.

According to the WHO, the corner stones for safe and effective blood transfusion services depend on 1. National blood transfusion service system existence, 2.Voluntary donations, 3.Blood testing and 4.Avoidance of unnecessary transfusions [18]. A country blood needs can be fulfilled if the 1%-2% of its population constitute the volunteer donors as per WHO. Thus, the challenges ahead in the developing countries are the limited infrastructure and

high cost for blood procurement, screening, storage, questionable safety of the available blood, low blood donation rates and the highest mortality rates.

It is evident that blood non-availability, directly affects maternal mortality. Refusal for Blood transfusion had higher maternal deaths than who accepted it, as evidenced in U. K. review of maternal deaths in 2002 and hence misconceptions regarding blood transfusion and alternate therapeutic option availability are to be discussed early with the pregnant women. If the needs for the blood arise in them, this could help to prevent the undue delay in getting the consent for the same.

The most populous nations are in the developing world. The most likely recipients of blood transfusion are women and children are in these countries. The developing world has the high prevalence for HIV, high blood shortages, the presence of fragmented and hospital based blood transfusion services together with the lack of proper testing and understanding affects the blood safety[16]. Transfusions are often whole blood in these resource poor countries which does not have negative outcome as estimated from post hemorrhagic organ failure [20].

The studies on the ABT alternatives like preoperative autologous blood donation are conducted in developed world. Also Perioperative hemodilution are to be used with caution in pregnancy. Availability of intraoperative cell saver, clotting factor concentrates, Recombinant Factor VIIa (rFVIIa), Erythropoietin (EPO) are to a limited access to a resource poor countries [16].

3.4 Obstetric Population-They Are Different!

It is a well known fact that every woman takes rebirth during her pregnancy / delivery. Their physiology and anatomy during pregnancy differs from that of the non pregnant state[21]. With advancements in Reproductive Medicine, the pregnancy in elderly age group is also increasing and associated co- morbid factors also increase, posing an added threat to her life. It is difficult to accurately quantify the Obstetric hemorrhage as she is bestowed with the high-level capacity to tolerate the Obstetric hemorrhage masking the vital signs[22]. Alloimmunization in pregnancy due to past or present pregnancy [1] might complicate the fetal life; produce a difficult situation for the transfusionist in providing the compatible blood units for her and her baby if the need arises. Blood transfusion in Obstetrics differs from other field, as most of the transfusions are given for the unexpected hemorrhages occurring in otherwise healthy women with a considerable variation in the Obstetric transfusion practice [23]. The guidelines formed for the Obstetric transfusion practice, especially on massive hemorrhage is usually are from the experiences of the general surgical population and from the War field [24], which could not be applied /suitable for this unique population .Thus all the potential mothers constitute a unique high risk population and are a challenge to the health care provider[25] although pregnancy is physiological[21].

3.5 Physiology of Pregnancy

There are many physiological and hematological changes occurring during pregnancy and puerperium as a result of hormonal influences of pregnancy.

Red Blood Cells (RBCs)

There is a total increase in the blood volume of about 1.5 liter, of which the 2/3^{rds} are held in the uterine vasculature and maternal blood spaces of the placenta. This increase is to meet the demand of pregnancy and also to balance the blood loss during delivery. By 6-12 weeks of pregnancy, the plasma volume expands by 10-15%. There is disproportionate increase in plasma, RBC, and Hemoglobin (Hb), which is 50%, 33%, and 18- 20% respectively .The plasma volume peaks at 32-34 weeks. There is also an increased iron demand during the 2nd trimester.

Increase in blood volume is more marked in the multiple pregnancies and in iron deficiency anemia. Increased Erythropoietin (EPO) increases the RBC mass, but is not proportionate to the plasma volume increase, leading to the physiological dilutional anemia of pregnancy. There is a drop in Hb of 1-2% by the late 2nd trimester and gets stabilized thereafter in the 3rd trimester, due to the reduction of the plasma volume which in turn due to increase in ANP resulting in diuresis and as result, there is increase in Hemoglobin (Hb) and Hematocrit (Hct) [21]. Pregnancies on iron supplementation have less pronounced changes in the drop in hemoglobin.

White Blood Cells (WBC)

WBC count increases during pregnancy and is due to the physiological stress of pregnancy and lower limit of the count is 6000 cells /cu.mm. Neutrophils are the majority in Differential Count. There is an impaired neutrophilic apoptosis of pregnancy with the cytoplasm showing toxic granulations, depressed chemotactic and phagocytic activity due to presence of the inhibitory factors during pregnancy. There is increased oxidative metabolism of the neutrophils. The immature myelocyte and metamyelocyte signifies the increased erythropoietic drive occurring during pregnancy. Lymphocyte decreases during the 1st and 2nd trimester but shows an increase in the 3rd trimester. Monocyte helps to prevent fetal allograft rejection by infiltrating into the decidual tissue (7-20th week). Absolute monocytosis occurs in pregnancy, especially in the 1st trimester, but decrease as gestation proceeds. Eosinophil and Basophil count does not alter significantly. The stress of delivery leads to a brisk leucocytosis [21.]

Platelets

The platelet count is decreased especially in the 3rdtrimester but it does not have the pathological significances which is termed as the gestational thrombocytopenia, and is partly due to hemodilution, partly due to platelet activation and accelerated platelet clearance. The lower limit in late pregnancy is 1.15 lac/cu.mm. The platelet volume distribution width increases and continuous as pregnancy advances, and but it can't be used as the sensitive

marker of platelet size. Post-delivery, the increased platelet count compensates the increased platelet consumption in the delivery process [21.]

Haemostatic Profile

Coagulation factors undergo significant changes during pregnancy. Fibrinogen, factors VII, VIII, X, XII, von Willibrand factor (vWF), Ristocetin co-factor activity increases as a result of increased protein synthesis mediated by the estrogen and thus make the pregnancy – a pro-thrombotic state. Activated Partial Thromboplastin Time (aPPT) is shortened by 4 seconds in the 3rdtrimester, no marked changes seen in Prothrombin Time and Thrombin Time.

Anticoagulants: Levels and activity of Protein C do not change. The biologically available Protein C levels (free) and the total proteins decrease as pregnancy advances. Levels and the activity of Antithrombin are usually unaltered in pregnancy and fall during labor and rises once again as soon after delivery. Acquired Activated Protein C (APC) resistance is found in pregnancy even when the factor V Leiden and Antiphospholipid antibodies are not present. And this is due to the high factor VIII, and factor V activity and low free protein levels. And hence the APC sensitivity ratio does not serve as the screening test for the factor V Leiden during pregnancy [21]

3.6 Blood Transfusion Physiology

Transfusion of blood and blood components helps to carry the oxygen effectively and also corrects the deficient, lost, consumed clotting factors by

replacing the constituent components of blood. The components available for use for transfusion practice are the RBCs, platelets, Fresh Frozen Plasma (FFP), and the cryoprecipitate [21]

WHOLE BLOOD (WB)

Its place in the modern blood transfusion therapeutics is that it provides the source material for component preparation[26,27] , but still it has the role in the situations of acute hemorrhage with the blood loss >25% to improve the oxygen carrying capacity and also to expand the plasma volume . Its use is futile if used to correct the coagulation abnormality, as it is with the deficient platelet and coagulation function and also with the significant diminished capacity of oxygen delivery when stored, as the 2, 3 Di Phospho Glycerate (2, 3 DPG) is decreased from 30% to 60%-70% in stored blood greater than 2 weeks and 3 weeks respectively, and thus it cannot deliver oxygen very effectively[27.]

RBC

RBC transfusion augments the oxygen delivery in the hope of avoiding the deleterious effects of hypoxemia [28]. Under the physiological conditions, the oxygen delivered and consumed or extracted by the tissues is 1000/ml and 200/ml respectively and their ratio comes to 5:1. In conditions (as in hypoxia, anemia and myocardial failure) where there is increased consumption but without the increase in delivery of the oxygen, the ratio up to which the patients are stable is 2:1 and beyond this stage they have to be helped out by transfusion. When there is good compensation, transfusion can be withheld

even when the Hb is <5.3% and Hct is 16% but when there is poor compensatory mechanism, transfusion has to be considered even though the Hb of >8.3% and Hct of 25%. The capacity to tolerate the low levels of Hb is based on the blood loss rate and magnitude, tissue perfusion state and the preexisting cardiopulmonary disease status. The increased Hb saturation and with increased 2, 3 DPG levels leads to an improved oxygen supply[29.] RBCs also play the role in hemostasis, with their passive rheological property on blood coagulation, reduce the bleeding time and significantly decrease in aPPT after RBC transfusion[27.]

The criteria of using the Hb level alone should not be the sole deciding factor about the RBC transfusion and other factors like intravascular volume status of the concerned individual, evidence for shock, extent and duration of anemia, cardiopulmonary physiologic parameters are too to be considered[27.]

Transfusion is given if Hb < 6% and not given if Hb is >10%. These conclusions may be altered in the presence of the anticipated blood loss. The intermediate Hb concentrations (Hb-6-10%) justify transfusion, if it is based on any ongoing indication of organ ischemia, potential or actual ongoing bleeding, the rate and magnitude of bleeding, the patients' risk factors for complications of inadequate oxygenation, the patient's intravascular volume status[30.]

PLATELETS

They are the small (2-3μ in diameter), anucleate cell fragments and metabolically active cells[24]. It binds to the injured site, also forms a scaffold of phospholipids, on which coagulation enzymes assemble for thrombin

generation. They also form the key proteins and molecular elements for fibrin clot formation[23]. The normal life span of platelets is 9-10 days. Random loss or consumption of platelets is 7000/μl/ day is not noticeable, but this is a significant loss in thrombocytopenic individuals and in individuals with the rapid destruction of platelets that occurs in Disseminated Intravascular Coagulation (DIC), Immune Thrombocytopenic Purpura (ITP). Platelets form the initial haemostatic plug which disperses in 24 -48 hours as Adenine Tri Phosphate (ATP) depleted in platelet and plug does not reform once it is broken, leading to inability to form the fibrin plug. Once fibrinogen is bound to platelets, it is further activated, leading to platelet aggregation. Exposing P-Selectin upon platelet activation cause Neutrophils and Monocytes to bind, get activated to exposed Tissue Factor (TF) and transfers this TF to platelets to further increase coagulation activation[24].

FRESH FROZEN PLASMA

FFP contains also the labile factors V and VIII and is the acellular blood component. It also has the naturally occurring ABO antibodies against the ABO antigens, but the AB plasma is devoid of the ABO antibodies and hence used in emergencies where it acts as a "Universal Plasma", got by centrifuging the citrated whole blood or donor apheresis[23.] Strengthening and stabilization of the formed clot is the function of the factors of the coagulation system.

CRYOPRECIPITATE

It is rich with the factor VIII, vWF, fibrinogen and fibronectin, factor XIII[23].

Low levels of coagulation factors and platelets are with increased risk of bleeding. Factor levels >50% of the normal, fibrinogen levels of about 1gm/L and platelet count of 50,000-1,00,000 /µ are usually sufficient to maintain the normal hemostasis.

3.7 Obstetric Conditions vs Risk of Blood Transfusion

These conditions are the nightmare for every Obstetrician on duty. They come across such instances due to derangements happening in various components of pregnancy process such as the **P**regnant patients, **P**ower of the uterus, **P**assenger –the fetus, **P**lacenta, **P**assage meant for delivery**, P**athology preexisting /occurring during pregnancy

Anemia

Anemia is a major public health problem [27] and is the commonest hematological problem in pregnancy, resulting in the lack of functioning RBCs[30.] Any patient with 11 gms% -11.5 gms% is considered as anemic at the start of pregnancy. The burden of anemia in pregnancy is 14% in developed countries, 65% - 75% in the Indian sub- continent and it contributes to 8-10 fold increase to MMR, when the Hb% is < 5gms% and this group of people could not tolerate even a 200ml of blood loss during delivery. Anemia contributes for about 20% direct and 20% indirect cause for MMR [32,33] .The associated Obstetrics co-factors like PIH, multiple pregnancies; APH still more worsens the outcome of anemia of pregnancy[32]. Anemia evolves in three stages as compensated (Hb-9.1-11gms% [WHO]), decompensate and goes for circulatory failure when the Hb% is <5 gms%. India has the highest burden of

anemic cases among the developing countries and has 12% of mild anemia (WHO-9.1gms% -11gms% of Hb%) 57% 0f moderate anemia (WHO-Hb of 7.1-9gms%) and 13% of severe anemia (Hb-<7 gms%).Adult women with 2 gms of iron needs an additional 1 gm of iron for her pregnancy and also has an increased iron demand in the 2nd trimester. Physiological dilution of pregnancy, pre-pregnant anemic status all contributes to anemia. Our Indian data shows the MMR is high with Hb of <8gms% and the resultant complications due to anemia are circulatory failure (78%), Pregnancy Induced Hypertension (16%), abruption (10%).Blood transfusion is advocated for chronic anemia if Hb <6gms% and <7gms%as per the American College of Obstetrics and Gynecology (ACOG) guidelines and Royal College of Obstetrics and Gynecology (RCOG) guidelines respectively.

Obstetricians concern is on the iron deficiency anemia which is chronic and hemorrhagic anemia due to acute blood loss. Well-being of Obstetric patients on Minimal Blood Transfusions (WOMB) study describes the effect of RBC transfusion on the Health Related Quality of Life (HRQoL)[34].

Early pregnancy complications

Early pregnancy complications that need blood transfusion are the abortions (which may be a threatened abortion, incomplete abortion, complete abortion, inevitable abortion, and missed abortion, illegal abortion and septic abortion), molar pregnancy and ectopic pregnancy. Women might have had become pregnant with the preexisting anemia. Abortions and molar pregnancy presents with heavy bleeding with the associated abdomen pain makes the

patient even, to go for a hypovolemic shock. Therefore, a careful assessment of the blood loss and wise and timely decision in the management helps to avoid the unnecessary exposure to the blood products. Blood utilization is 15.9% for abortion (intended and unintended) in a study by Elissa et al[14].

Patients with ectopic pregnancy present with the little bleeding associated with severe pain and with the short period of amenorrhea but they at times present with the Hypotensive shock due to hemoperitoneum, thus is a common cause of the maternal mortality. Diagnosis upon high suspicion, coupled with the emergency surgical management of the ruptured ectopic saves the maternal life. Unruptured Ectopic are managed with the medically, based on the established criteria for the same. It is wise to have the cross matched blood in hand as the degree of hemorrhage prediction is difficult in these cases. Accurately and timely diagnosed Ectopic pregnancy with the expertise in the minimally invasive surgical techniques rapidly carried over would restrict the exposure to blood components[35.]

Obstetric hemorrhage (OH)

All pregnant women must be considered to be at risk for OH [36] as the blood flow to the placenta is about 700 ml/minute at term, so bleeding is likely to be rapid and often unexpected and difficult to control , with the resultant acute blood loss thus usually of sudden event in Obstetrics. Serious hemorrhage may occur at anytime throughout pregnancy and puerperium. The life threatening anemia, leading to Obstetric Hemorrhage and the resulting

coagulopathy if not corrected with the timely availability of blood products, results in maternal.

Withstanding blood loss depends on the mother's hemoglobin status, her blood volume and blood loss volume status, and also the status of the co-existing disease and its complications4 .OH accounts for 3-4% of the RBCS transfused[37] and the single most [38] important cause of maternal death and accounting for the almost half of all postpartum deaths in developing countries with the case fatality rate of 1%. A 2.3% was the blood used for OH and the whole blood usage for OH is 43%,and 39% of Red Blood Cells and 19% of blood is used as the combination of the products[39].

Ante partum hemorrhage (APH)

APH is the bleeding per vaginum during pregnancy but before delivery and after the fetus establishes its period of the viability. It is primarily due to Abruptio placenta and Placenta praevia. Severe grades and the major types of abruption and placenta praevia is associated with major blood loss ,operative deliveries ,maternal morbidity and mortality .APHs are still more complicated with the coagulopathy development, Atonic PPH and may further proceed to the Massive Obstetric Hemorrhage (MOH) necessitating the activation of the Massive Transfusion Protocol (MTP).

The complications of the Abruption and placenta praevia are DIC, MOH, and PPH and the patient are usually high risk candidates for Caesarean hysterectomy/hysterotomy and for about twelve times more prone for blood transfusion risks. Major type of placenta praevia is a threat to both maternal

and fetal life and hence it is a routine practice in many centers to keep two units of cross matched blood units ready in the blood bank refrigerator to tackle the emergency[35].

Postpartum Hemorrhage (PPH)

The nightmare for every Obstetrician is facing the blood flood from the mother after the delivery of the fetus. A study on the Well being of Obstetrics patients on Minimal Blood transfusion [34]reveals that the 1/5th of MMR is due to PPH .There are no identifiable risk factors in a large proportion of who develop PPH [36]. The chances for the postpartum transfusion are always unpredictable.

The precise definition/ single definition and diagnosis for PPH are lacking and hence its exact incidence is also uncertain. Determination of the rate of clinically severe hemorrhage may be a more useful definition[36].

PPH is commonly defined as blood loss of ≥ 500mL after vaginal delivery of a baby, or ≥ 1000 ml after Caesarean section. However, these thresholds do not take into account on the pre-existing health status. In the developed world, most mothers show no sign of hypovolemia till 1000 ml of blood is lost. Hemorrhage within 24 hours of delivery is termed as primary and a hemorrhage after 24 hour is termed as secondary[36]. Persistent (ongoing) PPH is active bleeding >1000ml within 24 hours following birth that continues despite the use of initial measures including first- line uterotonic agents and uterine massage. PPH severity and response to treatment is influenced by the rate and volume of blood loss[36].

The four main groups of PPH are 1. uterine atony, 2. Placental problems (abruption, retained placenta, abnormal implantation) 3. Trauma of the genital tract, 4.Systemic medical disorders (including inherited and acquired coagulation defects). The major cause for primary PPH which accounts 80% is due to atony[36] .The blood utilization figures for PPH is 32.9%, in conditions with Hb is 7.1 gms%[14].

Caesarean Section (CS)

It is the most commonly performed surgical procedure for fetal /maternal indications in the Obstetrics. This population is largely young and healthy[40] but with the potential risk for major intra-operative blood loss. The advancements in the anesthesia, supporting the surgical means of delivery and combating the PPH with the alternative surgical procedures have revolutionized the Obstetrics outcome. The indications for the CS and the quantity of blood loss decide the risk of blood transfusion. With the unexpected sudden hemorrhage occurring due to the manipulation of highly vascular uterus, some hospitals have a protocol with 2 units ready before performing an elective CS, leading to the delay in performing cases with the non-availability of blood, but most patients/unit were not transfused.

High risk patients undergoing CS, need routine cross matching. Developed countries are with better awareness on blood transfusion, the routine cross matching is so infrequent and also not recommended which is contrast to the developing countries[40].

Varying blood ordering practice for CS exists. Blood loss assessment is difficult to estimate because of dispersion of lost blood and blood being mixed with the amniotic fluid. Various studies estimated 930ml-1106ml of blood loss in CS. Duthie estimated the blood loss with alkali Hematin method and found 487ml in singleton undergoing CS. Blood grouping, saving the serum for cross matching, clotting screen are unnecessary before CS in uncomplicated pregnancies. If there is absence of significant factors, Type & Screen for CS should be eliminated but to face a situation of emergency, O negative is transfused[40,41].

CS in labor is associated with more blood loss than delivery via naturalis and planned CS deliveries. Women undergoing CS had the mean drop of Hb of 4.2%[42]. Earlier studies in U.K evidenced a 56% cross matches performed for elective CS and 64% for emergency CS. Anemic woman are less able to tolerate the blood loss in CS[43]. A blood loss of >1000ml seen in 1.3% of the CS and 0.7% have loss >1500ml. CS under general anesthesia has commonly found to be associated with increased blood loss. Ante partum hemorrhage (APH), Placenta praevia, rupture uterus accounts for 21% of cases of blood loss >1000ml in U.K. The leading and the direct cause of maternal death in CS is thromboembolism in U. K.[44].

The length of the hospital stay, incidence of post-operative infection and wound complications were similar in spite of low hematocrit after CS in transfused(mean 0.28) and non-transfused (0.23) patients as per Naef et al[45]. Clinical symptoms of anemia are rare in low hemoglobin levels and estimating

routinely the post operative hemoglobin has a limited use as a screening procedure[38].

Transfusion rate was 8.9% during the intraoperative and within 24 hrs of surgery as per the Faponle et al study. In developed countries the transfusion rate is 0.66%-1.1% but from a study in Ethiopia showed a transfusion rate of 19%[41]. Repeat CS had the transfusion rate of 6.7% a. Placenta praevia is associated to 6.5 times higher transfusion rate than the controls. In an Indian study by Madhusudan Dey et al the CS rate is 27.3% and blood transfusion rate for this is 1.7%[38].

DIC

The Obstetric conditions with the risk of DIC occurrence are retained products of conception, sepsis, eclampsia, abruption, amniotic fluid embolism and intra uterine death. Massive transfusion in the management of Obstetric hemorrhage is also an inciting event for DIC. These events cause fibrinogen and clotting factor biodegradation, resulting in hemorrhage and microvascular thrombus formation. This condition is managed effectively by treating the cause for DIC along with the transfusion support by administering red cells, platelets, plasma. Cryoprecipitate which is rich in factor VIII and fibrinogen is also used for microvascular bleeding in fibrinogen deficiency, if present[46].

HELLP

HELLP-Hemolysis, Elevated Liver Enzyme, Low Platelet Count is an entity associated with severe PIH**,** occurring 4%-12% in PIH mothers.

Increased platelet destruction/consumption leads to risk of postpartum Hemorrhage. Acute renal failure sets in 7% of the patients. A transfusion rate of 38%-93% is seen in HELLP cases. Platelet therapy depends on severity of the thrombocytopenia, anticipated mode of delivery with concurrent bleeding episodes.[47]

8. Transfusion Risks

The adverse reactions reported by the U.K. national Hemovigilance in 1996-1999, showed 54.2% of the adverse effects were due to incorrect blood transfusion due to clerical identification errors. Transfusion Transmitted Disease (TTI) accounts 3%of transfusion complications. One of the five main strategies to increase the viral safety is to avoid unnecessary transfusions and the other being strict door selection procedure, screening the blood for viruses, viral inactivation and removal procedures.[48]

Bacterial contamination occurs 1 in 3000 platelet concentrate units .It may induce sepsis approximately 1 in 6 recipients of contaminated products. It is a standard practice to subject platelet units for Bacterial culture prior to issue in various countries and India has the long way to go for due cost constraints and inventory logistics.[49]

Even now the Hemolytic Transfusion Reaction (HTR) due to clerical error is the major cause of mortality in blood transfusion. Incorrect blood component transfusion as per Serious Hazards of Transfusion (SHOT) study occurs more commonly or highly prone to occur in emergency transfusion situations.[50]

The recent studies have documented the additional risk of occult hepatitis B infections (HBsAg negative but De-oxy ribo Nucleic (DNA) positive) for Hepatitis B Virus (HBV), as transfusion transmitted infection (TTI).[51]

Blood transfusion is also associated with specific pathologies and with deleterious outcomes like Transfusion Associated Lung Injury (TRALI), Transfusion Associated Circulatory Overload (TACO), Transfusion Related Immunomodulation (TRIM), Transfusion Associated Graft versus Host Reaction (TA-GVHD).[8] SHOT has not reported blood transfusion as the cause of death in Obstetric population. Since this population is not exposed to studies about the role of TRALI and other severe immunological reactions due to the massive transfusion.[50]

3.9 Benefits of transfusion

The persistent negative approach on the blood transfusion therapy is due to the studies done mainly about its impact on the adverse effects .The impact of the blood transfusion therapy on the decline of the maternal deaths and on the clinical benefits had never been quantified in the past .But the study by Hendricks et al. has showed that there is a risk of increase in maternal death of 6.5 fold in the face of unavailability of blood for transfusion in the Obstetric care setting and there is seriously of increased risk in maternal mortality in people who refuse blood due to religious considerations as seen in Jehovah's Witnesses.[20]

3.10 Blood Conservation &Alternatives

The rational decision of not to transfuse in patients with Hb % >8gms% is the most effective blood conservation technique. But this policy is confounded with the rapidly changing clinical situation and also the need to stay ahead or atleast up with, the continuing blood loss in the parturient since transfusion is risky but bleeding to death is fatal. The various procedures adopted for blood conservation are Preoperative autologous blood donation (PAD), Acute Normovolemic Dilution (ANH), Intra-Operative Cell Salvage (IOCS). Elective CS with indications prone for very high risk of bleeding as in cases of placenta accreta, massive fibroids and in those with exceptional cross-matching difficulties may benefit from PAD. The role of PAD is also limited in the Obstetric setting.[37] Also the Pre-delivery autologous blood deposit is not recommended as per the Green- top published RCOG.[52]

Compared to other blood conservation techniques, IOCS is more effective and useful in Obstetrics, as a life saving procedure of re-cycling operative blood loss and maintain the tissue oxygenation. A National Institute for Centre of Excellence (NICE) guideline for IOCS is that it should be carried out in tertiary care centre and to be regularly audited. Its use in CS is reported in many studies without any reported complications[27.]

ANH is the immediate pre-operative/pre-delivery collection of the blood from the patient donor, with the simultaneous replacement of the collected blood with the similar volume of the colloids or the three times the volume of the crystalloids so as to maintain the normovolemia.[46]

The available transfusion alternatives are hematinics agents (iron, EPO), which are given prior to surgery or delivery. Hemostatics, IOCS, ANH are the therapeutic modalities available to the patients refusing transfusion.[53] The World Maternal Antifibrinolytic (WOMAN) Trial, a large, international, randomized, double-blind, placebo-controlled trial, will be addressing the role of tranexamic acid in women with a clinical diagnosis of PPH and data collection is due to finish in 2016.[52]

3.11 Clinical Transfusion Practice in Obstetrics

Clinical transfusion practice is an evolving sub-specialty .Its main concern is about the procurement of blood and its appropriate use.[2] Paucity of literature exists regarding the trends and the predictors of clinical transfusion practice.[54] Variations in surgical blood transfusion policies among hospitals and countries results in less optimal transfusion practice. Inspite of minimal infectious threat due to transfusion, utmost importance is be given to minimize or avoid inappropriate transfusions.

Trends in blood component usage

Few decades ago, transfusion of whole blood was the mode of transfusion practice. The components use in the transfusion practice helps to optimally utilize the scarce resource. There is an increase in blood usage for medical indications from 52 % to 62%[55] and a decline of transfusion episodes in the surgical field. An increase in use of platelets is seen among the industrialized nations. Concern about the appropriate use of blood and blood

components is on raise to maximize the blood utility.[56] Blood conservation and alternatives are considered to minimize the risks of blood transfusion.[27]

Blood Ordering Schedule

It is a guide to the normal blood transfusion requirements for common surgical procedures. This schedule is based on the hospital transfusion practice with the involvement of the surgical staff. It gives the list of number of blood components units that should ordinarily be cross-matched before an elective surgical procedure. These cross- matched units should satisfy 90% of the patients'[57] intraoperative requirements**.** Preoperative over ordering had been documented from 1973 by Friedman et al.[58] With the use of the blood utilization indices the efficiency of usage of the blood ordering is measured**.**

Cross-Match Ratio (C/T Ratio)

It is the ratio between the total number units cross-matched to transfused. This was first suggested by Boral and Henry. A cut -off value 2.5 indicates efficient usage, but the ideal ratio is 1.The C/T ratio was commonly used in patients with Caesarean mode of delivery and its value reported in the Obstetrics is 2.9 to 64. Kameni et al suggested a C/T ratio of 3.5 could be achievable.[59,60] The elective Caesarean deliveries had high C/T ratio reported and for other conditions like abruption, repeat LSCS, PIH were reported with the C/T ratio of 3.8, 5.8, 8.5 respectively.[61]

Transfusion Probability (%T)

This gives the probability of transfusion for a given procedure .This parameter was suggested by Mead et al. in 1980. Its value is >30% suggests the significant blood usage.[62] A Taiwan study recommends that the blood request is not needed if the Transfusion probability is<5% and type and screen done if its ≥ 5% or an anticipated blood need is more than 2 units .Cross- match is preferred if the procedure needs an average≥ 2 units or the patient is positive for antibody screening.[63]

Transfusion Index (TI)

It gives a value which suggests the average number of units used per patient cross-matched. A value of >0.5 is indicative of efficient usage.[62]

Pretransfusion testing

Various types of pretransfusion testing carried out based on the need for transfusion in the patient. They are type only, type and hold, type and screen, type and cross- match. ABO and Rh type only does not have a value.

Type and Screen is to test the patients sample for ABO and Rh, and screen for unexpected antibodies and the sample stored for future cross-matching if the need for transfusion arises. With a negative screen, no blood is cross matched for reserve but when transfusion need arises, the ABO and Rh compatible blood issued by abbreviated cross-match, done by immediate spin method or computer cross-match. But if the antibody screen is positive it is

followed by the identification of the antibody and red cell units with the corresponding antigen negative blood is issued.[63]

Type and screen avoids the tie up of cross- matched blood units during reservations at the time of ordering, enhancing a better blood inventory. With a high chance of need for transfusion, type and cross-match is preferred, but with conditions of less transfusion probability, type and screen is advocated.[64]

Transfusion Guidelines

Guidelines formulated are poorly applicable in clinical transfusion practice. Physicians face conflicting information about transfusion decisions. Inconstant transfusion practice is due to the dynamic clinical situations and patient variables. Transfusion decisions made empirically due to the non-availability of laboratory data also results in inappropriate transfusions hence optimal transfusion practice is difficult to define. Case-by-case consideration is needed to optimize transfusion.

Guidelines for Red cell usage

American Society of Anesthesiologists (ASA) guidelines for managing acute anemia, says transfusion rarely indicated if Hb->10 gms% but almost required without exception if Hb<6 gms%. For the intermediate Hb%, the decision to transfuse is based on the rate and magnitude of blood loss, patient's cardiopulmonary reserve, and factors affecting the oxygen consumption factors.

College of American Pathologists (CAP) recommend transfusion if there is a rapid blood loss of 30-40% of the patient estimated blood volume. For the intermediate levels, decision to transfuse depends on the presence of tachycardia and hypotension even after volume replacement or the tissue oxygenation is compromised with mixed venous O_2 partial pressure of <25 mmHg, oxygen extraction ratio >50%, oxygen consumption <50% of the baseline.[48]

RCOG recommendation for red cell units in Obstetric transfusion practice indicates transfusion with Hb - <6gms%. And not indicated with Hb>10 gms%.[51] Transfusion Trigger:

1. "10/30 rule (Hb-10 gms% /Hct -30%), was the used as a transfusion trigger for many decades, to overcome the poorer outcome of the surgery patients with less Hb%. Accumulating evidence exists for the less Hb trigger is not associated, with the increased risks, especially if the blood loss <500 ml. However, frequent occurrence of silent, asymptomatic Perioperative myocardial ischemia in patients with limited cardiac reserve is seen.

2. Other triggers like invasive monitoring of oxygenation which as a routine is not feasible but can be used in specific situations.

3. Symptoms of anemia is also used a trigger as done by Toy et al. He noted an increased heart rate with reduced self –scored energy with Hb of 5 gms%, which gets cleared with RBC transfusion.

4. As per American College of Physicians, vital sign changes are used as transfusion trigger. But an anesthetic agents may mask these changes. A silent ischemia can occur even with stable vitals.[48]

5. Health –related Quality of Life (HrQoL) as an alternative to Hb level is used as a transfusion trigger rather than using Hb alone.[67]

Guidelines for plasma usage[48]

FFP Transfusion indications: It is not to used in the management of hypovolemia as per ASA, CAP, BCSH, NIH

1. If patient had been transfused with more than one volume, in bleeding patients for the verified coagulation factor deficiency i.e. PT<0.50 and aPPT 1.5 times normal.

2. Correction of known coagulation factor if the specific concentrates not available,

3. For Warfarin immediate reversal.

A dose is 10-15 ml/kg and for Warfarin reversal 5-8 ml/kg is recommended.

Guidelines for platelets usage[48]

Platelets Transfusion Indications:

1. In patients with thrombocytopenia, undergoing surgery with the platelet count<50 $x10^9$/l, prophylactic platelet is given

2. For any surgical procedure with high risk of bleeding, a count of 50-100x10^9/l is recommended.

3. In bleeding patients, if the count falls <50x10^9/l, transfuse platelets.

4. Major non-surgical bleeds in Cardiopulmonary bypass/ and Neuro-surgical procedures, high thresholds of platelet count required.

5. Repeated platelet count in massive transfusion guides the platelet transfusion therapy and the dose required for platelets is 1unit/10 kg.

Guidelines for cryoprecipitate usage[48]

It is rich with factor VIII and fibrinogen. Its use is indicated to treat diffuse microvascular bleeding when the fibrinogen levels is<1 gm/L.

Principles of replacement of blood loss[48]

The primary aim in acute blood loss is to resuscitate and maintain the blood volume. To have adequate oxygen delivery and hemostasis achievement, blood transfusion therapy with RBC, plasma and platelets has to be established as per the critical needs of the patient.

A blood loss of 20% managed with crystalloids and colloids. Further ongoing blood loss managed with the RBC transfusion which is based on the rate and magnitude of blood loss and patient's ability to compensate for the decreased oxygen carrying capacity by increasing the cardiac output. Instead of whole blood usage, if RBCs are transfused to replace the blood loss, may result in dilutional coagulopathy.

Coagulation factors required to have adequate hemostasis is 20-30% of the normal clotting factors, which are reduced if there is a loss the twice blood volume. A loss of 1.5 blood volume loss /replacement results in the reduced fibrinogen levels. In addition there is prolonged PT and APPT. Further prolongation of 1.5 -1.8 times than the control values of PT and APPT, has a tendency to bleed. Therefore, the situation of abnormal bleeding, prolonged coagulation, deficiency of coagulation factors and fibrinogen are managed with the FFP transfusions. Initially 4 units rapidly transfused, followed by additional units of FFP for every use of 6 units of RBC units.

A two blood volume loss/replacement results with a platelet count of $50x10^9$/l and eventhough this count is adequate for the surgical procedures. In the context of massive transfusions, a level >80-100x109/l is preferable. Hence, an abnormal bleeding and thrombocytopenia is managed with the 1 unit of platelets for every 10 kg body weight.

3.12 Appropriateness

Transfusing the safe blood products only to treat a condition with significant morbidity or mortality that cannot be prevented or managed effectively by other means, is called as the appropriate use of blood[65] which is the necessity for the hour ,prevents the blood transfusion hazards ,narrows the demand supply ratio. This approach of minimizing the blood use is called the blood management[66]

There is no single test to measure the rate /degree of appropriateness. Most of the guidelines laid down for the decision to transfuse are based on the

hemoglobin values. The guidelines are being accepted by the treating clinicians but not put into practice[15]. Also, the clinical transfusion practice is with the great variations**.**

As per the RCOG guidelines for the Obstetrics transfusion practice, it is appropriate if transfusion is indicated with Hb <6 gms% and inappropriate if done when the Hb is >10 gms%.[52] In a patient with Hb of >10 gms% transfusion is appropriate if there is an anticipated blood loss. The transfusion in the group with intermediate value of Hb 6-10 gms% is duly considered as justified one with the ongoing indication of organ ischemia, intravascular status of the patient, rate and magnitude of the potential or actual ongoing bleeding, presence of the risk factors leading to the complication of the inadequate oxygenation.

WHO does not recommend the use of single unit transfusion. It raises the Hb with the minimal benefit to the patients.[66] Single unit transfusion should be considered appropriate if given with good clinical judgment .Some evidence shows that a documentation of the indicated transfusion lowers the inappropriate transfusion.[52] The usage of 80-85% as the WB in clinical transfusion practice contributes to 25% of inappropriate use due to WB, rather than the component usage.[15] International Red Cross estimates that the usage of blood would come down to 30% if appropriately used.[15]

So-Osman et al, in his study found that the 48% of the transfusion were inappropriate.[67] The inappropriate transfusion range prevailing in the developed country is 18-35%[15] and the same in India is 30-60%.[15] Putting the appropriate

use in practice needs consistent efforts of education with the change in behavior, which would gradually eliminate the transfusions which were inappropriate.

So- Osman et al in their study had pointed that the inappropriate transfusions were of less percentage (25%) in a massively transfused patients and is 84% in the non- massively transfused patients. They have also added that there must be a role played by over-estimation of inappropriateness due to the high Hb values in the early postpartum period when the plasma distribution not yet completed. . But there may also an under estimation of the real Hb values in the early postpartum period due to the plasma redistribution.[68]

Duvekot et al. had opined that there may not be symptoms of anemia in patients with a relatively large decrease in Hb levels. Similarly this may happen in the acute postpartum anemia without hemodynamic consequences and symptoms with the low Hb values. In such patients the goal of transfusion is to improve the health related quality of life. Womb study may throw light about using the parameter, Health –related Quality of Life (HrQoL) as an alternative to Hb level as a transfusion trigger rather than using Hb alone.[69]

Single Unit transfusions

WHO restricts the transfusion with the single unit as it does not benefit the patients with anemia[65] and has resulted in the clinical transfusion practice of two unit transfusions. Diverse opinion exists among the treating personnel regarding this entity of blood transfusion. Scarce availability forces them to transfuse what is available - i.e. the single unit, as something is worth than

nothing. The appropriateness of this transfusion could be considered if ordered with good clinical judgment. In countries with resource constraints, single unit transfusion could be considered acceptable[15]. One study in Canada addresses this issue that it would be an effective but simple, blood and cost -saving strategy reducing the ABT risks.[15] Studies by Sabeen Afzal, Khan et al. and Ozumba et al had documented a rate of 11.1%[15], 66.2%[43] and 43.1%[70] of single unit transfusion respectively. In the more stable clinical setting, single unit transfusion gives an opportunity to assess the response to a transfusion.

Whole blood usage

The usage of 80-85% as the Whole Blood (WB) in clinical transfusion practice contributes to 25% of inappropriate use due to WB, rather than the component usage. International Red Cross estimates that the usage of blood would come down to 30% if appropriately used [15].

A study by James Alexander et al. noted the use of whole blood has a definite role in managing the Obstetric hemorrhage. Their study outcome found that Acute Tubular Necrosis of kidney was less associated with whole blood use (0.2%) than with the RBC usage (2%) and combination of usage of blood products (4%).[39] Moreover their study found that the Whole blood group discharged with the normal creatinine levels, but the RBC transfused group had derangement in the creatinine levels and underwent dialysis, discharged with normal creatinine levels and few had continued dialysis due to chronic failure.

4% was the rate of pulmonary edema in the whole blood transfused group and the group which had a transfused with combination of blood

products had 7% of pulmonary edema. An emerging evidence for the whole blood usage over component therapy is found when dealing with the case with serious OH and hence the usage of whole blood in hemorrhagic case had to be reconsidered.[39] It is the alternative to the more expensive and infra-structure dependent blood components. Moreover, it has the added advantage of fewer exposures of donors in patients.[71]

3.13 Monitoring the Clinical Transfusion Practice

In recent times, optimal use of blood products has become an integral part of national Hemovigilance system in few countries like Belgium, Ireland, and Netherlands.[6] Regular audits on the clinical transfusion practice together with Continuous Medical Education programs disseminate the knowledge on the appropriate and optimal use of the blood resource.[72]

4. MATERIALS AND METHODS

Study Area

The study was done in the Department of Transfusion Medicine, The TamilnaduDr.M.G.R.MedicalUniversityandGovernmentKilpaukMedicalCollege Hospital, Chennai in association with the Department of Obstetrics and Gynecology, Government Kilpauk medical college hospital, Chennai.

Study Design

It was a descriptive cross-sectional study.

Study Population

Obstetrics in-patients for whom blood requests were given.

Study Period and Sample Size

All Obstetrics in-patients fulfilling study criteria, during August 2014 and July 2015.

Study Procedure

The study protocol was approved by the Ethical Committees of both University and institute. All the patients were classified according to their diagnosis. Clinical and blood transfusion details were obtained from the individual's case record, blood request forms and reservation/issue registers. The received blood request were processed and cross-matched as per the hospital transfusion guidelines.

The following variables of the study population were recorded.

- Patient Demographics
- Blood Group & Rh Typing
- Obstetrics history and Diagnosis
- Indication for transfusion
- Hemoglobin level
- Components requested and issued.

Following indices were used to know about the efficiency of the blood utilization practice[62]

1. Cross-match to Transfusion Ratio (C/T ratio)[62]

$$\text{Cross-match to Transfusion Ratio} = \frac{\text{No. of units cross-matched}}{\text{No. of units transfused.}}$$

It gives the efficiency of blood ordering practice and the ratio of > 2.5 indicates an excessive cross-matching is carried out for that condition.

2. Transfusion Probability (%T)[62]

$$\text{Transfusion Probability} = \frac{\text{No. of patients transfused}}{\text{No. of patients cross-matched}} \times 100$$

A value more than30% is considered as significant blood usage.

3. Transfusion Index (TI) [62]

$$\text{Transfusion Index} = \frac{\text{No. of units transfused}}{\text{No. of patients cross-matched.}}$$

This gives the information about the average number of units used per patient.

The appropriateness of the Red Cell Transfusion in Obstetrics arrived by using the RCOG guidelines for blood transfusion in Obstetric patients.

RCOG Guidelines for appropriate use of Red cell transfusion in Obstetrics[75]

- "Transfusion is rarely indicated in stable patients when hemoglobin is greater than 10gm/dl."
- "Transfusion is almost indicated when hemoglobin is less than 6gm/dl."
- "For patient in labor or immediate postpartum period, with hemoglobin level is less than 7gm/dl; decision to transfuse should be made according to the individual's medical history, age and symptoms."
- "For patients in immediate postnatal period, hemoglobin level less than 7 to 8gm/dl, where there is no continuing or threat of bleeding, the decision to transfuse should be made on an informed individual basis. In fit, healthy, asymptomatic patients there is little evidence of benefit of blood transfusion."

Inclusion Criteria

Obstetrics in-patients for whom blood requests was given.

Exclusion Criteria

Obstetrics in-patients who are not willing to participate in study.

Statistical Analysis

The data collected was transformed to Microsoft Excel. Statistical analysis was done with SPSS software, version 17. Ratios and proportions between various groups were used to express the C/T ratio, Transfusion Probability, Transfusion index.

5. RESULTS

During the study period there were 3169 Obstetrics admissions with a total 2936 deliveries. The Obstetric in-patients of 1010 for whom blood transfusion request given comprised the study population which constituted 31.9% of the total admissions. Out of the 1010, number of patients received transfusion were 969, which is 95.9%.

The results of the study were analyzed under the following sub- headings:

1. Blood utilization vs age groups.
2. Blood utilization vs Parity
3. Blood Group & Rh Type Distribution
4. Analysis of the Blood Ordering in Obstetrics Transfusions
5. Overall blood utilization
6. Blood utilization vs Obstetric conditions
7. Blood utilization indices (overall and for specific diagnosis) for red cells transfusion
8. Appropriateness of red cell transfusion as per RCOG guidelines
9. Single unit transfusions
10. Whole blood transfusions

4.1 Blood Utilization vs Age Distribution

4.1a. Age Distribution

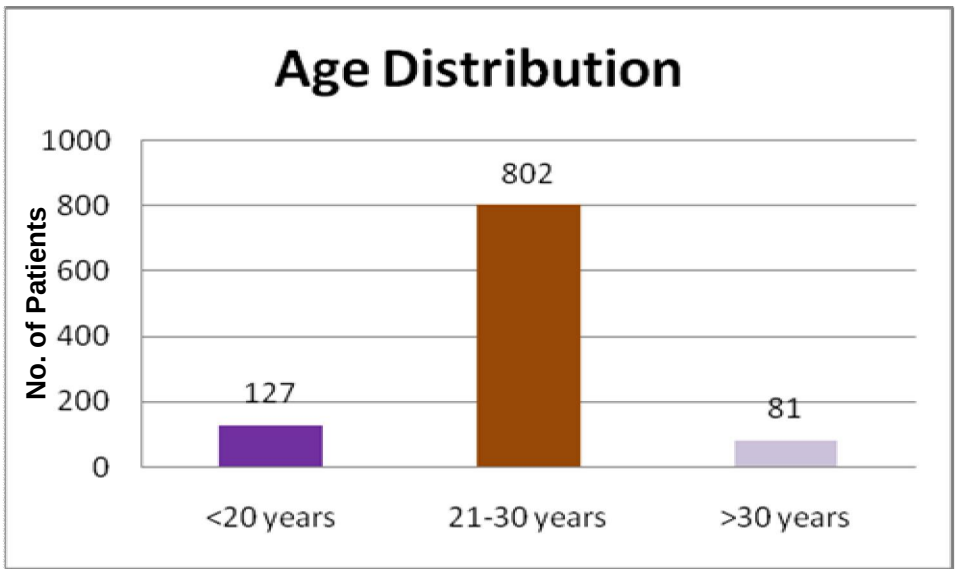


Fig. 1 Age distribution

The maximum and minimum age was 40 years and 16 years in the study population. The 21-30 year age group constituted the highest percentage among the study population.

4.1b. Age vs transfused and non-transfused population

TABLE 1: Age vs transfused and non-transfused population

Age in years	Study population	Transfused population	Non-transfused population
>20 years	127(12.6%)	123(96.8%)	4(3.2%)
21-30 years	802(79.4%)	766(95.5%)	36(4.5%)
>30years	81(8.0%)	80(98.8%)	1(1.2%)

4.1c. Blood utilization among the different age groups

TABLE 2: Blood utilization among the different age groups

Age in years	Requested units	Transfused Units	Non- utilized units
<20 years	199	220	10
21-30 years	1415	1758	74
>30 years	174	262	0

Among the transfused population,>30 years group had the highest transfusion utilization percentage (98.8 %). The non-transfused population was high in the 21-30 years group (4.5%). The age group which had the high number of blood transfusion and the components usage was 21-30 year group (1758 units). All the blood products issued to >30 year age group had been fully utilized.

4.2 Blood Utilization vs Parity

TABLE 3: Blood Utilization vs Parity

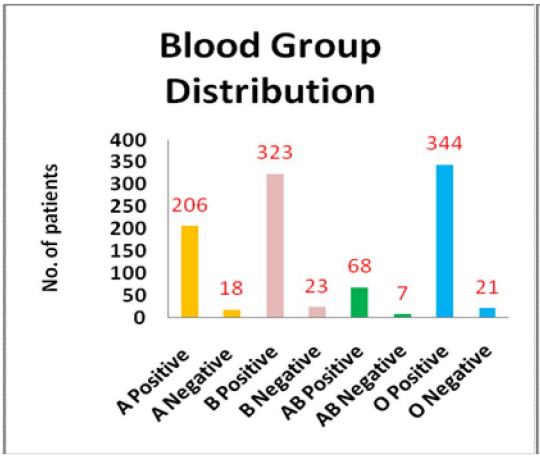
Parity	No. of cases	Requested Units					Transfused Units				
		WB	RBC	Plasma	Platelet	Cryo	WB	RBC	Plasma	Platelet	Cryo
Primi Para	350	41	466	42	14	0	39	450	207	56	0
Multi Para	660	99	977	94	48	7	94	943	290	135	26

WB – Whole blood, RBC – Red blood cell

660 cases of multiparous women had utilized 943 units of RBC units. Primiparous women were transfused with 450 RBC units.

4.3 Blood Group Distribution

The distribution of the blood groups among the study population were A Positive (20%), A Negative (2%), B Positive (32 %,) B Negative (2%), AB Positive (7%), AB Negative (1%), O (34%), O Negative (2%) reflecting the blood group distribution of the general population. The prevalence of Rh D status in this Obstetrics population was 6.8%.



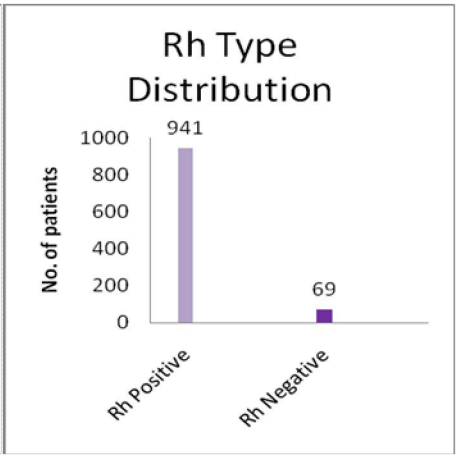


Fig.2 **Fig.3**

Fig. 2 & 3 Blood Group & Rh Type Distribution

Out of the 2cases of Hydatidiform mole, one case was O positive and another case was A Positive.

4.4 Analysis of the Blood Ordering in Obstetrics Transfusions

4.4a Analysis of the Blood ordering among patients

TABLE 4: Analysis of the Blood ordering among patients

Analysis of Requests	Total	WB	RBC	Plasma	Platelet	Cryo-precipitate
No. of patients for whom blood requested	1010	76	981	94	35	3
No. of patients not transfused	41	6	40	6	1	0
No. of patients transfused	969	70	941	88	34	3

WB – Whole blood, RBC – Red blood cell

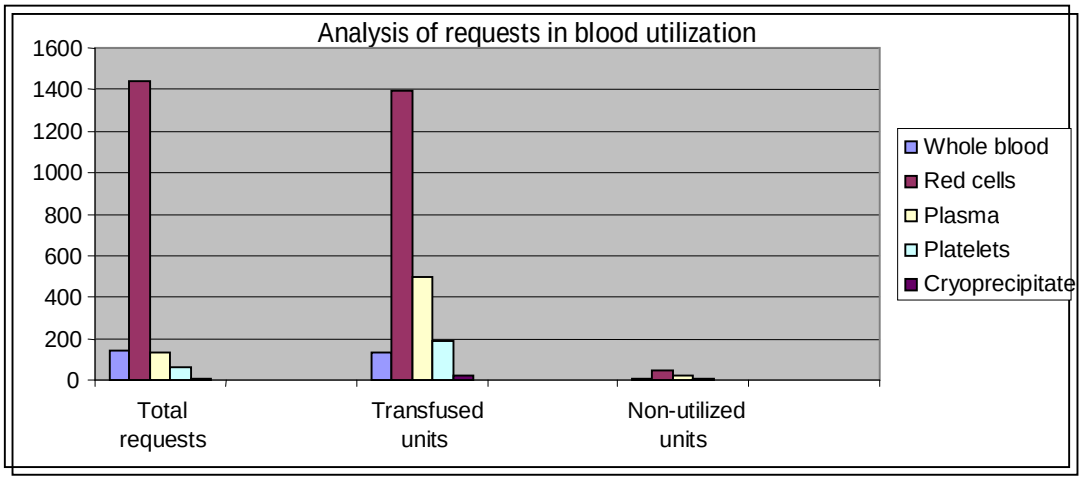
4.4b Analysis of the Blood ordering on the basis of the requests

TABLE 5: Analysis of the Blood ordering on the basis of requests

Units	Total units	WB	RBC	Plasma	Platelets	Cryo-precipitate
Requests	1788	140	1443	136	62	7
Cancelled units	84	7	50	21	6	0
Transfused units	2240	133	1393	497	191	26

A total of 1788 requests were processed for various blood and blood components in 1010 patients. Red cell requests of 1443 were given. Out of them 1393 requests were used for 941 patients.

Fig. 4 Analysis of blood ordering among patients



4.5 Overall blood utilization in Obstetrics

TABLE 6: Overall blood utilization in Obstetrics

Overall Utilization	Total Patients	Total Units	WB Units	RBC Units	Plasma Units	Platelet Units	Cryo Units
Requested units	1010	1788	140	1443	136	62	7
Transfused units	969	2240	133	1393	497	191	26
Cancelled units	41	84	7	50	21	6	0

Red cell units (1393) of were the most commonly transfused blood component, followed by Whole blood units (133). All the Cryo precipitate requested had been fully utilized**.**

4.6 Blood Utilization based on the Clinical Diagnosis

6a. Blood Utilization Based on the Clinical Diagnosis

TABLE 7: Blood Utilization Based on the Clinical Diagnosis

Diagnosis	No. of cases	Units Requested					Units transfused				
		WB	RBC	Plasma	Platelets	Cryo	WB	RBC	Plasma	platelets	Cryo
Anemia	506	5	773	0	0	0	3	736	0	0	0
Abortions	64	5	88	2	4	0	5	88	8	12	0
Ectopic Pregnancy	29	25	43	3	0	0	24	43	10	0	0
Hydatidiform Mole	2	2	3	0	0	0	2	3	0	0	0
APH	67	38	129	64	32	7	37	123	241	100	22
Abruptio Placenta	43	29	81	52	28	6	25	73	201	83	22
Placenta praevia	24	9	48	12	6	1	12	50	39	17	0
PPH	175	74	295	83	30	1	70	289	314	92	8
DIC	23	22	56	45	34	5	22	56	178	103	18
HELLP	5	8	18	18	14	0	8	18	68	49	0
CS	352	62	527	91	39	7	62	505	345	120	26
Vaginal delivery	352	36	475	21	6	0	30	457	85	13	0

Anemia complicating pregnancy was common among the study population (50.1%), which had also utilized the red cell component (30.1%) to a maximum followed by the Caesarean section cases (20.6%). The plasma, platelets and cryoprecipitate had been utilized by the complicated cases of Caesarean delivery(Caesarean hysterectomy) with the utilization percentage of 21.1%, 18.3%, and 25.7% respectively. The cases of Obstetric Hemorrhage comprised 21% of the study population which had utilized 16.8% of the RBC units.

TABLE 8: Blood Utilization Based on the Clinical Diagnosis in Percentage

Diagnosis	Total Patient percentage	Utilization percentage	
		WB	RBC
Anemia	50.1%	2.2%	30.1%
Abortion	6.3%	1.5%	3.6%
Ectopic pregnancy	2.8%	7.1%	1.8%
Hydatidiform Mole	0.1%	0.6%	0.2%
APH	6.6%	11%	5%
Abruptio Placenta	4.3%	7.9%	2.9%
Placenta Praevia	2.4%	3.1%	2.1%
Vaginal delivery	34.9%	8.9%	18.7%
Caesarean Sections	34.9%	18.3%	20.6%
PPH	14.4%	20.7%	11.8%
DIC	2.2%	6.5%	2.3%
HELLP	0.3%	5.3%	0.7%
Overall	100%(n=1010)	95%	96.5%

6b. Mode of delivery vs blood utilization

TABLE 9: Mode of delivery vs blood utilization

Mode of Delivery	No. of cases	Requested Units					Transfused Units				
		WB	RBC	Plasma	Platelet	Cryo	WB	RBC	Plasma	Platelet	Cryo
Vaginal	352	36	475	21	6	0	30	457	85	13	0
CS	352	62	527	91	39	7	62	505	345	120	26
Instrumental	18	4	17	20	0	0	4	17	20	0	0

6c. Blood Utilization vs Caesarean Delivery

TABLE 10: Blood Utilization vs Caesarean Delivery

CS	No. of cases	Requested Units					Transfused Units				
		WB	RBC	Plasma	Platelet	Cryo	WB	RBC	Plasma	Platelet	Cryo
Elective	36	3	55	5	1	0	3	51	16	4	0
Emergency	316	59	472	86	38	7	59	454	329	116	26
Primary CS	210	48	323	75	27	7	48	311	285	93	26
Repeat CS	142	14	204	16	12	0	14	194	60	27	0

Among the Caesarean cases, elective sections were 10.2 %(36 cases) and the repeat sections were 40.3% (142 case). Emergency and the primary sections had utilized the red cells of 454 units and 285 units respectively.

6d. Utilization of other blood components

TABLE 11: Utilization of other blood components

Utilization of other components	Total Patient (requested)	Total Patients (transfused)	Total Requests	Total Transfused Units	Total Cancelled Units
Plasma	94	88	136	497	21
Platelets	35	34	62	191	6
Cryoprecipitate	3	3	7	26	0

TABLE 12: Indications for Transfusion of other components

Indication based on the Clinical Diagnosis	No. of cases	Plasma Units	Platelet Units	Cryoprecipitate Units
APH	35	241	100	22
Abruptio Placenta	25	202	83	22
Placenta Praevia	10	39	17	0
PPH	42	314	92	8
DIC	23	178	103	18
HELLP	5	68	69	0

Utilization percentages for plasma, platelets, cryoprecipitate were 95.6%, 97% and 100% respectively.

4.7 Blood Utilization Indices for red cell utilization

4.7a Blood Utilization Indices for Red Cell Component usage

TABLE 13: Blood Utilization Indices for Red Cell Component usage

Diagnosis	Crossmatched		Transfused		C/T ratio	% T	TI
	patients	units	patients	units			
Anemia	506	773	477	736	1.1	94.3%	1.5
Abortion	64	88	64	88	1	100%	1.4
Ectopic Pregnancy	29	43	28	43	1	96.6%	1.5
Hydatidiform Mole	2	3	2	3	1	100%	1.5
Ante partum Hemorrhage	67	129	62	123	1.02	92.5%	1.8
Abruptio Placenta	43	84	38	78	1.1	88.4%	1.8
Placenta praevia	24	51	23	50	1.02	95.8%	2.1
Vaginal delivery	352	475	330	457	1.04	93.8%	1.3
Caesarean delivery	352	527	340	505	1.04	96.6%	1.4
Postpartum Hemorrhage	175	295	168	289	1.02	96%	1.7
DIC	23	56	20	56	1	87%	2.4
HELLP	5	18	5	18	1	100%	1
Overall	1010	1443	969	1393	1.03	96%	1.3

C/T Ratio – Cross-match/Transfusion ratio
%T – Transfusion probability
TI – Transfusion Index

4.7b Maximum Blood Order for Obstetric diagnosis

TABLE 14: Maximum Blood Order for Obstetric diagnosis

Diagnosis	TI	Maximum Blood Order (TI x 1.5)
Anemia	1.5	2.25
Abortion	1.4	2.1
Ectopic Pregnancy	1.5	2.25
Hydatidiform Mole	1.5	2.25
Ante partum Hemorrhage	1.8	2.7
Abruptio Placenta	1.8	2.7
Placenta praevia	2.1	3.1
Vaginal delivery	1.3	1.9
Caesarean delivery	1.4	2.1
Postpartum Hemorrhage	1.7	2.6
DIC	2.4	3.6
HELLP	1	1.5

4.8 Appropriateness for Red Cell Transfusion

TABLE 15.Transfusion Indication vs Hemoglobin Range

Indications	Cases	Hemoglobin Range (gms %)					Appropriate Transfusion in Patients	Inappropriate Transfusion in Patients
		<6	6-7	7-8	8-10	>10		
Anemia	**With symptoms**	30	26	81	32	2	361 cases (71.4%)	145 cases (28.6%)
	Without symptoms	47	54	89	111	34		
	Total cases	77	80	170	143	36		
Obstetric Hemorrhage	**APH**	6	6	17	21	17	67 cases (100%)	0 %
	PPH	2	24	54	58	37	175 cases (100%)	0%

Out of 143 cases anemia, under the Hemoglobin range of 8-10 gms%,110 cases had underwent emergency Caesarean sections. In cases with Hemoglobin >10 gms %,29 case had undergone Caesarean sections. Inappropriate transfusion rate was 28.6%.

4.9 Single Red Cell Transfusion

TABLE 16: Single Red Cell Unit Transfusion

Single Units			Hemoglobin Range (gms %)				
No. of Cases Transfused	**No. of Units Transfused**	**No. of cancelled units**	**<6**	**6-7**	**7-8**	**8-10**	**>10**
619	619	8	55	67	207	215	75

The rate of single unit transfusion was 61.3%

4.10 Whole Blood Transfusion

The usage of whole blood for 61.3 cases indicated for Obstetric Hemorrhage .

Table 17: Whole Blood Usage

Whole Blood			Indication(No. of cases)		
No. of Cases Transfused	**No. of Units Transfused**	**No. of cancelled units**	**APH**	**PPH**	**Caesarean**
70	133	7	18	37	15

6. DISCUSSION

Blood, an altruistic resource, has to be maximally utilized, taking into the consideration of the future growing demand for red cells in modern therapeutics. Blood transfusion –a mini transplantation procedure is also potentially hazardous in spite of measures to aspire a 'zero risk' strategy.

Blood transfusion is the fail safe element in the Obstetrics management who are bleeding to death, with its significant role in reducing the maternal mortality. Optimal utilization of the same is the need for the hour to overcome its clinical and economical disadvantages.

The appropriate use of blood is the subject of debate, due to the lack of consensus among clinicians. Monitoring the transfusion practice with the established guidelines helps to use the resource appropriately, avoid unnecessary transfusions. This study prospectively evaluates the blood utilization practice in Obstetrics.

Obstetrics in-patients admitted during the study period were 3169. The Obstetrics in-patient included in the study, for whom blood transfusion requests given were 1010. The study population constituted 31.9% of the admitted patients and the transfused population constituted 30.6% among the total admissions. Our hospital is a tertiary centre, handling all types of Obstetric emergencies. Added to this, was also a high Caesarean section rate, as mostly the Primary Health Centre takes care of the normal deliveries. The Obstetrics transfusion rate in Natukunda et al[14]. , Buggie et al[14]. was 17%.and that of J.A.

Patterson et al.[23] was 1.4%. A dramatic change in reduction of red cell usage for General surgical cause by 40% in the past 10- 12 years had been reported by Hazel Tinegate et al. which was not monitored in medical or Obstetrics and Gynecological setting. WHO has documented a 37% transfusion rate for the pregnancy related complications

Blood utilization vs age distribution: The maximum and minimum age was 40 years and 16 years in the study population. The 21-30 year age group constituted the highest percentage among the study population. Among the transfused population,>30 years group had the highest transfusion utilization percentage (98.8%). The non-transfused population was high in the 21-30 years group (4.5%). The age group which had the high number of blood transfusion and the components usage was 21-30 year group (1758 units). All the blood products issued to >30 year age group had been fully utilized. In one study of Osaheni et al[76]. 57.6% of 21-30 year age group received transfusion .

Blood Utilization vs Parity: Primiparous and multiparous women constituted 34.8% and 65.3% among the study population respectively. The red cell component usage was 450 RBC units (32.3%) and 943 units (68%) for the primi and multipara respectively. It was not statistically significant ($p>0.05$).Osaheni et al[76] study showed a 44.4% of primi had the risk of transfusion.

Blood Group and Rh type distribution: The blood group distribution in Obstetric patients was similar to that of the general population, O (34%) group being the maximum and Rh D negative type being 6.8%.

Analysis of the blood ordering practice in Obstetric Transfusions: Out of the 1010 patients in the study population, 41 (4.1%) patients had not utilized the requested blood. In our institute it is not a routine practice to reserve blood for the normal deliveries and uncomplicated Caesarean deliveries. For the outcome of vaginal or operative delivery in the healthy and uncomplicated parturient the routine cross-match is not recommended by the American Society of Anesthesia Practice Guidelines for Obstetric Anesthesia [64].

The maximum requests were for red cell component (80.7%) followed by Whole blood requests (7.8%).The requests for Cryoprecipitate was the least -0.4%. A request rate of 2.7% was unused in overall transfusion. The requests rate of 2.6% and 1.5 % was the unused for the cases of Anemia complicating pregnancy and Caesarean sections respectively. The number of elective caesarean cases were 36 (10%) and 0.2 % of the requests were unused among the reservations. But the studies by Penney et al[73] had the 89% requests has the cover for surgeries or diagnosis in Obstetric conditions.

Blood Utilization, based on specific diagnosis and indication of the transfusion

The overall blood utilization rate was 96.4%. Obstetric Hemorrhage required a Whole blood transfusion rate of about 31.7% (APH-11% PPH-20.7%). Caesarean sections, DIC and HELLP cases had utilized whole blood -18.3%, 6.5%, and 5.3% respectively. Red cell transfusion rate was high (30.1%) in cases of anemia, followed by the cases of Caesarean delivery (20.6%) and Obstetric Hemorrhage had utilized 16.8%. Silverman et al[77] in his study noted,

PPH (34%) was the commonest cause for transfusion. Kameni et al[59] had a similar outcome of blood usage for PPH (51%) in contrast to our study as the developing countries house the global burden of anemia .Plasma usage was the highest among the Hemorrhagic case, nearly 23%. Platelets and Cryoprecipitate usage was also highest in Hemorrhage -19.2% and 29.7% respectively.

Utilization of the other components: Utilization percentages for plasma, platelets, cryoprecipitate were 95.6%, 97% and 100% respectively. 497 units FFP were transfused to 88 patients. 241 units for APH, 256 units for PPH were transfused. 191 units of platelet concentrates were transfused to 34 patients. 103 units were transfused for 23 cases of DIC and 69 units were transfused for 5 cases of HELLP syndrome. 26 units of Cryoprecipitate units were transfused to 3 patients, out of which 18 units were transfused to 2 cases of DIC and 8 units were transfused to 1 case of PPH.

Blood Transfusion vs Mode of delivery: The Caesarean section rate in our study was 48.9%, which was the above the upper limit set by WHO (Caesarean rate to be not more than >15%). The blood and blood components utilization was found to be high in Cesarean deliveries. While considering the mode of delivery, the Red cell usage was 52.6% in Caesarean deliveries and is due to rising trend of Caesarean sections .The red cell transfusion rate in Caesarean sections and Vaginal delivery was 20.1% and 18.7% respectively. The Klapholz et al[78]. reported a transfusion rate of 1.7 % for vaginal deliveries and 5.2% for Caesarean deliveries. Goundan et al[61] in his study found the transfusion rate of 12.2% for caesarean sections.

Blood utilization Indices: Our study had the C/T Ratio of 1.03. A study by Kameni et al[59] showed 2.9. A C/T ratio of 9.7 was the outcome of one another study by Khan et al.[43] in Pakistan. The total elective cases were 36 among a total of 352 caesarean sections. Being a cEmOC, with high rate of referral cases of high risk pregnancies, most of the transfusion requests are raised as the emergency transfusion episodes. The overall transfusion probability was 96% in the present study, but it is 9.3% in the study of Penny et al.[73] Transfusion index was 1.3 in the present study.

Appropriateness of Red Cell units: The present study had 28.6% as the inappropriate transfusions. Under the Hemoglobin range of 8-10 gms%,110 cases had undergone emergency Caesarean sections. In cases with Hemoglobin >10 gms %,29 case had undergone Caesarean sections. So- Osman et al[68]. study showed 46% as the inappropriate transfusions. A study by Parker et al[79] revealed inappropriate transfusion were 31% in the patients with Hb of >7 gms% in the absence of ongoing bleeding in asymptomatic anemic case.

Single Unit: One study in Canada addresses this issue that it would be an effective but simple, blood and cost -saving strategy reducing the ABT risks. Studies by Sabeen Afzal[15], Khan et al[43]. and Ozumba et al[70] had documented a rate of 11.1%, 66.2%, and 43.1% of single unit transfusion respectively. In the present study the single unit transfusion rate was 61.3%. If the anemia identified early in pregnancy, an opportunity exists for patients to receive the most appropriate transfusion sparing strategy and reduction in single unit transfusion.

Whole Blood Transfusion: A total of 133 Whole blood units were transfused to 70 patients. Whole blood transfused more commonly in Obstetric Hemorrhage (37 cases) accounting 31.7%. Among the 29 cases of ectopic pregnancy, 25 units of whole blood transfused which more commonly encountered a hemoperitoneum of around 2000ml.

Osaheni et al [77]. reports 70% as the whole blood utility in Obstetrics transfusion practice.James et al. reported a 43% usage of whole blood in Obstetrics[39]

TABLE: 17 Comparison Table of present study outcome with other studies

1. Obstetrics Transfusion Rate				
Place	**Author**	**Year of Study**	**Study Population**	**Transfusion rate**
Chennai, India	Present Study	2015	1010	30.6%
New South Wales, Australia	J.A. Patterson et al.[23]	2015	3914	1.4%
Malawi	Bugge et al.[14]	2013	-	17%
Abakaliki, South -East Nigeria	Osaheni et al.[76]	2012	151	7.4%
Uganda	Natuknda et al.[14]	2010	-	17%
Netherlands	So –Osman et al.[67]	2009	2873	3%
Toronto	Silverman et al.[77]	2004	33795	0.65%
Kenya	Lackritz et al.[14]	1993	-	13%
2. Parity				
Chennai, India	Present Study	2015	1010	Primi-34.7%
				Multi-65.3%
Abakaliki, South- East Nigeria	Osaheni et al[76]	2012	151	Primi-44.4%
				Multi-44.6%
3. Age distribution				
Chennai, India	Present Study	2015	1010	>20 years-12.6%
				21-30 years-79.4%
				>30years-3.1%
Abakaliki, South -East Nigeria	Osaheni et al[76]	2012	151	>20 years-6.6%
				21-30 years-57.6%
				>30years-25.8%

4.Blood component usage				
Chennai, India	Present Study	2015	1010	WB-6.9%
				RBC-93.1%
Texas	James et al.[39]	2009	66369	WB-43%
				RBC-39%
Abakaliki, South -East Nigeria	Osaheni et al[76]	2012	151	WB -70%
				RBC -30%
5. Indication of Transfusion				
Chennai, India	Present Study	2015	1010	Anemia-30.1%
				OH-16.8%
Abakaliki, South -East Nigeria	Osaheni et al[76]	2012	151	Anemia-72.2%
				OH-19.2%
Toronto	Silvermanet al.[77]	2004	216	OH-34%
-	Kamani et al.[59]	1988	6003	Anemia-12%
				OH-73%
-	Parker et al.[79]	2006	222	Anemia-43%
				OH-22%
6.Mode of delivery vs Transfusion Rate				
Chennai, India	Present Study	2015	1010	Vaginal-18.7%
				CS-20.6%
Pune, India	Madhusudan Dey et al.[38]	2013	173	CS1.7%
Chandigarh, India	Goundan et al.[61]	2011	1769	CS-12.2%
Enugu	Ozumba et al.[70]	2006	463	CS -25.2%
Nigeria	Faponle et al.[41]	2005	641	CS-8.9%
Massachusetts	Klapholz et al.[78]	1990	30621	Vaginal-1.7%
				CS-5.2%

7. Blood Utilization Indices				
Chennai, India	Present Study	**2015**	**1010**	C/T Ratio-1.03
Chandigarh, India	Goundan et al.[61]	2011	1769	C/T RATIO-5.46
-	Kameni et al.[59]	1988	6003	C/T Ratio-2.9
South West Nigeria	Oluwarotimi et al.[40]	2010	1056	C/T Ratio-7.4
Karachi, Pakistan	Khan et al.[43]	2002	126	C/T Ratio-9.7
Chennai, India	Present Study	2015	1010	Inappropriate-28.6%
Netherlands	So-Osman et al[67]	2009	2873	Inappropriate-46%
	Parker et al.[79]	2006	222	Inapproptiate-31%
Toronto	Silverman et al.[77]	2004	216	Inapproptiate-32%
Single unit Transfusion				
Chennai, India	Present Study	2015	1010	61.3%
Abakaliki, South-East Nigeria	Osaheni et al[76]	2012	151	44.4%
Islamabad	Sabeen Afzal[15]	2011	350	11.1%
Enugu	Ozumba et al[70]	2006	463	43.1%
Karachi, Pakistan	Khan et al.[43]	2002	126	66.2%
-	Kameni et al.[59]	1988	6003	5%

7. SUMMARY

In our study on evaluating the blood utilization practice in Obstetrics,

- 969 cases out of 1010 patients were transfused with blood and components in different combinations.
- For 506 cases of anemia complicating pregnancy, 736 red cell units were utilized.
- 505 red cell units were utilized for total number of 352 cases of caesarean delivery, of which 454 red cell units were transfused for 316 cases of emergency LSCS. 194 red cell units for 142 cases of repeat LSCS.
- Out of 1443 units red cell units cross matched 1393 units were transfused. C/T Ratio derived was 1.03.
- Out of 1010 patients cross-matched, 969 patients were transfused. Transfusion Probability derived was 96%.
- 1393 red cell units were transfused for 1010 cross-matched patients. Transfusion Index derived was 1.3.
- Numbers of single red cell units transfused were 619 units (61.3%).
- 133 units of whole blood were transfused for 70 cases.

- As per the RCOG guidelines of Hb values, 145 patients(28.6%) were inappropriately transfused with RBC units. 111 patients were in Hb range of 8 to 10 gm%. 34 patients were in the Hb range of >10gm%

- 497 units FFP were transfused to 88 patients. 241 units for APH, 256 units for PPH were transfused.

- 191 units of platelet concentrates were transfused to 34 patients. 103 units were transfused for 23 cases of DIC and 69 units were transfused for 5 cases of HELLP syndrome.

- 26 units of Cryoprecipitate units were transfused to 3 patients, out of which 18 units were transfused to 2 cases of DIC and 8 units were transfused to 1 case of PPH.

8. CONCLUSION

In our study, 71.4% of the red cell units transfused were considered appropriate according RCOG guidelines for blood transfusion in Obstetrics.

In the present study percentage of single unit RBCs transfused (61.3%). It could be kept to a minimum if the treatment of anemia is optimal during the pregnancy.

Blood utilization indices were well within normal limits because majority of the blood units (86.1%) transfused were for emergency LSCS.

However, inappropriate use of red cell units can be reduced further (to less than 28%) by avoiding transfusion for patients with Hb of more than 10 gm% and also for asymptomatic anemic patients with Hb of 8-10 gm%.

Adequate blood inventory always allays obstetrician's apprehension of blood availability. At the same time since in a country like India where demand is always more than supply, appropriate use of blood components is repeatedly emphasized.

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THE TAMIL NADU Dr. M.G.R. MEDICAL UNIVERSITY

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E-mail : mail@tnmgrmu.ac.in Fax : 91-44-22353698

INSTITUTIONAL ETHICS COMMITTEE

Address of Ethics Committee: The Tamilnadu Dr MGR Medical University Chennai, India	
Principal Investigator: Dr. M. Sri Devi , MBBS	
Proposal title: Evaluation of Blood Utilization practice in Obstetrics – A Prospective Study. Presenter: **Dr. M. Sri Devi , MBBS** **(ECMGR0309036)**	
Documents filed	✓
Protocol	✓
Informed consent documents	✓
Any other documents	

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INSTITUTIONAL ETHICS COMMITTEE

NAME OF MEMBER	DESIGNATION	SIGNATURE
Prof. D. SHANTHARAM **M.D., D. Diab** VICE CHANCELLOR, THE T.N. DR.MGR MEDICAL UNIVERSITY	**Chairman**	
MR. ANAND DAVID UNIVERSITY STANDING COUNSEL THE T.N. DR.MGR MEDICAL UNIVERSITY	**Member**	
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Dr. PERIANDAVAR MD INSTITUTE OF DIABETOLOGY GOVERNMENT GENERAL HOSPITAL, CHENNAI	**Member**	
DR.SABARATNAVEL, MD DEPARTMENT OF MEDICINE, GOVERNMENT HOSPITAL, ROYAPETTAH.	**Member**	
DR. SARAVANAN MDS. DEPT. OF ORAL SURGERY GOVERNMENT DENTAL COLLEGE, CHENNAI	**Member**	A
DR. M. LOGAMANIAN, M.D.,Ph.D. NATIONAL INSTITUTE OF SIDDHA, CHENNAI.	**Member**	19/6/14
Dr. R. P. ILANGHO, M.D DEPT. OF RESPIRATORY MEDICINE, APOLLO HOSPITAL, CHENNAI.	**Member**	
Dr. S. MINI JACOB, M.D DEM, THE T.N. Dr. MGR MEDICAL UNIVERSITY	**Member Secretary**	19/6/14

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DECISION

Opinion of the institutional Ethics Committee-PLEASE CHECK ONE

✓ Approved with modification

_____ Modification required prior to approval (please specify on the space below)

_____ Disapproved

Date of review: 19/6/14

Signed : _____ (please print name) DR. D. SHANTHARAM

(please delete as appropriate, Chairperson, Secretary)

Modification needed Root Questionnaire to be obtained / Research outcome to be modified.
The Study should be done in the National Institute of Siddha instead of Chennai Corporation schools.
The pilot study should be done in adults.

The research proponent is hereby informed that the Institutional Ethics Committee will require the following:

1) All adverse drug reaction (ADRs) that are both serious and unexpected to be reported promptly to the IEC within 7 working days.

2) The progress report to be submitted to the IEC at least annually.

3) Upon completion of the study, a final study status report to submitted to the IEC.

INSTITUTIONAL ETHICAL COMMITTEE
GOVT.KILPAUK MEDICAL COLLEGE,
CHENNAI-10
Ref.No.6371/ME-1/Ethics/2014 Dt:04.09.2014.
CERTIFICATE OF APPROVAL

The Institutional Ethical Committee of Govt. Kilpauk Medical College, Chennai reviewed and discussed the application for approval "A Prospective Study of evaluation of blood utilization practice in Obstetrics" – For Project Work submitted by Dr.M.Sridevi, MD (IH & BT), Dept. of Transfusion Medicine, PG Student, TN MGR Medical University, Chennai-32.

The Proposal is APPROVED.

The Institutional Ethical Committee expects to be informed about the progress of the study any Adverse Drug Reaction Occurring in the Course of the study any change in the protocol and patient information /informed consent and asks to be provided a copy of the final report.

GOVT. KILPAUK MEDICAL COLLEGE
29 SEP 2014
Kilpauk, Chennai-10.

29/9/14

CHAIRMAN,
Ethical Committee
Govt.Kilpauk Medical College,Chennai

26/9/2014-
29/9/14

PATIENT INFORMATION SHEET

EVALUATION OF BLOOD UTILIZATION PRACTICE IN OBSTETRICS - A PROSPECTIVE STUDY

Acute blood loss is a sudden event in obstetrics contributing to maternal mortality and blood transfusion is recognized as one of the essential components of cEmONC. This study is designed to study the current transfusion practice in Obstetrics.

AIM

To evaluate the blood utilization practice in Obstetrics patients.

PROCEDURE

Data will be collected from Case records, Blood request forms and Blood Bank records for analysis.

BENEFITS AND RISKS

There is no risk for patients enrolled in this study.

CONFIDENTIALITY

Your privacy will be protected in so for as permitted by law. Only your researcher and Ethical committee members will have access to the data collected during the study.

PARTICIPATION

Your participation in this study is voluntary and you are free to decide now or later whether to continue or discontinue from the study.

NAME OF THE PATIENT:

SIGNATURE :

DATE :

CONSENT

I confirm that I read and understood the information about the above research study dated _____ and I received chance to ask the questions.

My participation in this study is voluntary and I know that I am free to withdraw from the study at any time, without giving any reason and without affecting of my legal rights.

I agree to this access. I know that my identification will not be revealed in any details that is released to third persons or published.

I agree not to restrict or interfere with any data or results that are obtained from this study.

I agree to participate in this research study for the above listed purpose.

Patient's name :

Signature : Date :

Signature of the person who obtains consent : Date :

Patient IP Number :

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kfgNgW kUjJt Jiwa;y FUj;Nawwg gadghlbidg gww;a MaT.

Fw;f;Nfhs:

kfgNgW kUjJt Jiwa;y mDkj;ffggLk ngzfSffhd FUj;Nawwg gadghL kwWk mtww;d Kiwahd jdik fzlw;jy.

nra;Kiw:

kfgNgW kUjJt Jiwa;y mDkj;ffggLk ngzfs;d kUjJtkid Fw;gNgLfs› ,ujjf$Wfs Ntzb t;zzggqfs kwWk ,ujj tqf;a;y css Fw;gGfs Mf;ait ngwgglL MaTfF clgLjjggLk.

gyd;fSk; ghj;gGfSk:

kfgNgW kUjJt Jiwa;y mDkj;ffggLk ngzfSfF ,ujjf$Wfs nrYjJtij ,ej MaT KiwggLjj cjTk.

NgWfhy r;f;rir Kiwa;Nyh ,ujjf$Wfs nrYjjggLtj;Nyh Muharr;ahsu jiya;Ltj;yiy. Mifahy NgWfhy ngzfSfF vttj ghj;gGk ,yiy.

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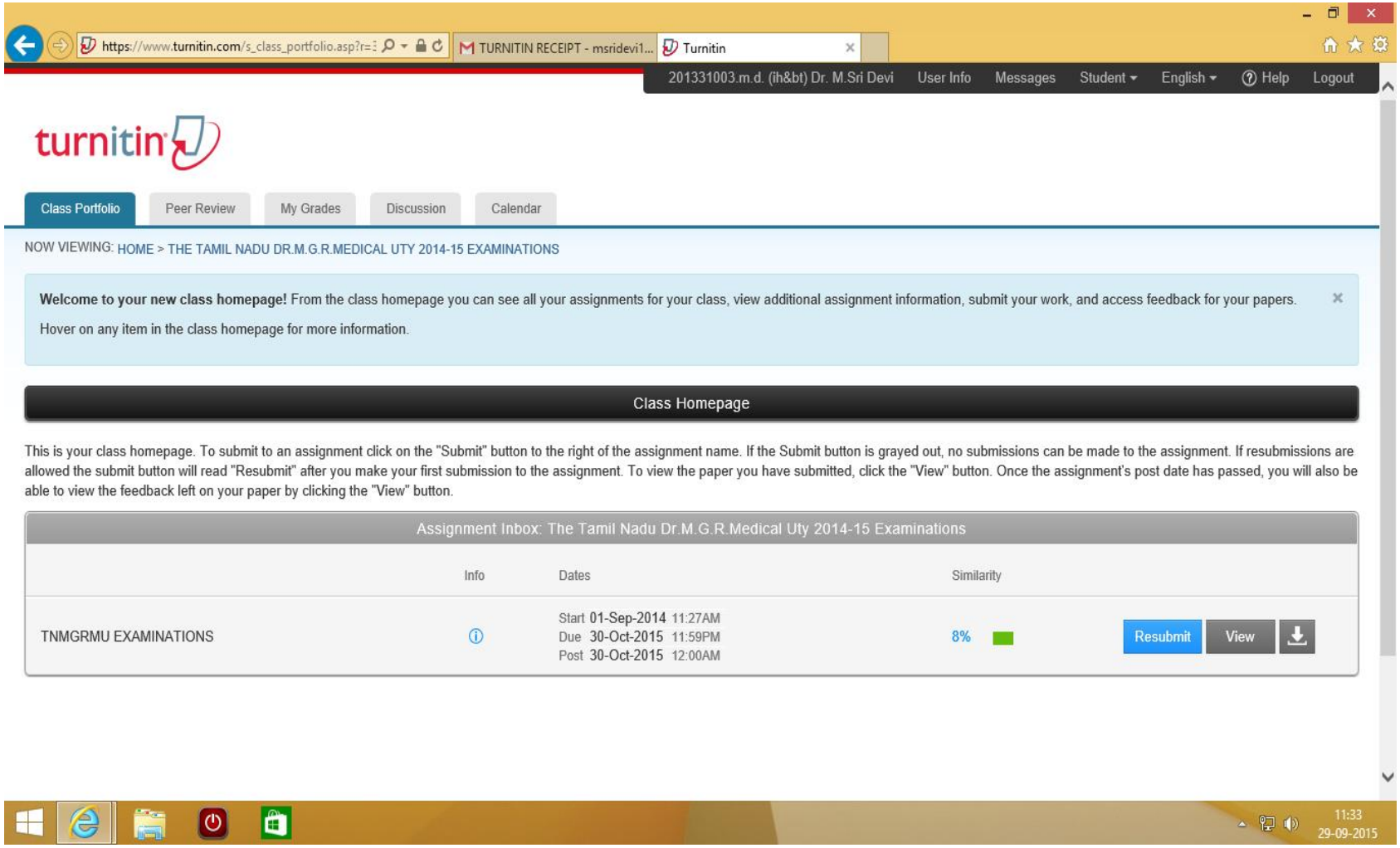
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KEY FOR MASTER CHART					
Abbreviation	**Expansion**	**Abbreviation**	**Expansion**	**Abbreviation**	**Expansion**
R	Request	f	FFP (Fresh Frozen Plasma)	pn	Postnatal
C	Cancelled	plt	Platelet	anem	Anemia
T	Transfused Units	cr	Cryoprecipitate	sym	Anemia with Symptoms
wb	Whole Blood	t	Total	hb 1	Hemoglobin <6 gm%
r	RBC (Red Blood Cell)	an	Antenatal	hb 2	Hemoglobin 6-7 gm%
hb 3	Hemoglobin 7-8 gm%	abor	Abortion	abr	Abruptio Placenta
hb 4	Hemoglobin 8-10 gm%	d.c	Dilatation and curretage	hys	Hystrectomy
hb 5	Hemoglobin >10 gm%	ecto	Ectopic Pregnancy	pl.pr	Placenta Praevia
PIH	Pregnancy Induced Hypertension	ves	Vesicular Mole	CS	Caesarian Section
HELLP	Hemolysis, Elevated Liver Enzymes, Low Platelets	APH	Antepartum Hemorrhage	em	Emergency
preL	Previous LSCS	sec	Secondary PPH	Ato	Atonic PPH
vag	Vaginal Delivery	ret pl	Retained Placenta	PPH	Post Partum Hemorrhage
inst	Instrumental Delivery	tra	Traumatic PPH	DIC	Disseminated Intravascular Coagulation

MASTER CHART

S.No.	age	bg	parity	t.R	R.wb	R.r	R.r1	R.f	R.plt	R.cr	C	C.wb	C.wb1	C.r	C.r1	C.f	C.f1	C.plt	C.plt 1	C.cr	C.cr1	T.t	T.wb	T.wb1	T.r	T.r1	T.f	T.f1	T.plt	T.plt1	T.cr	T.cr1	anem	sym	hb1	hb2	hb3	hb4	hb 5	PIH	HELLP	abor	ecto	APH	abr	hys	pl.pr	CS	em	preL	vag	PPH	DIC
1	40	3	0	2	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	1	2	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	1	1	0	0	0	0
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4	23	1	1	2	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	1	1	1	4	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	1	1	2	0	0	1	0	0	1	0
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6	23	3	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1	0	0	0	0	0	0	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	22	4	1	2	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	1	2	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
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169	21	7	0	5	0	1	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	1	4	1	4	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	1	0
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176	23	7	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0
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230	25	7	1	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
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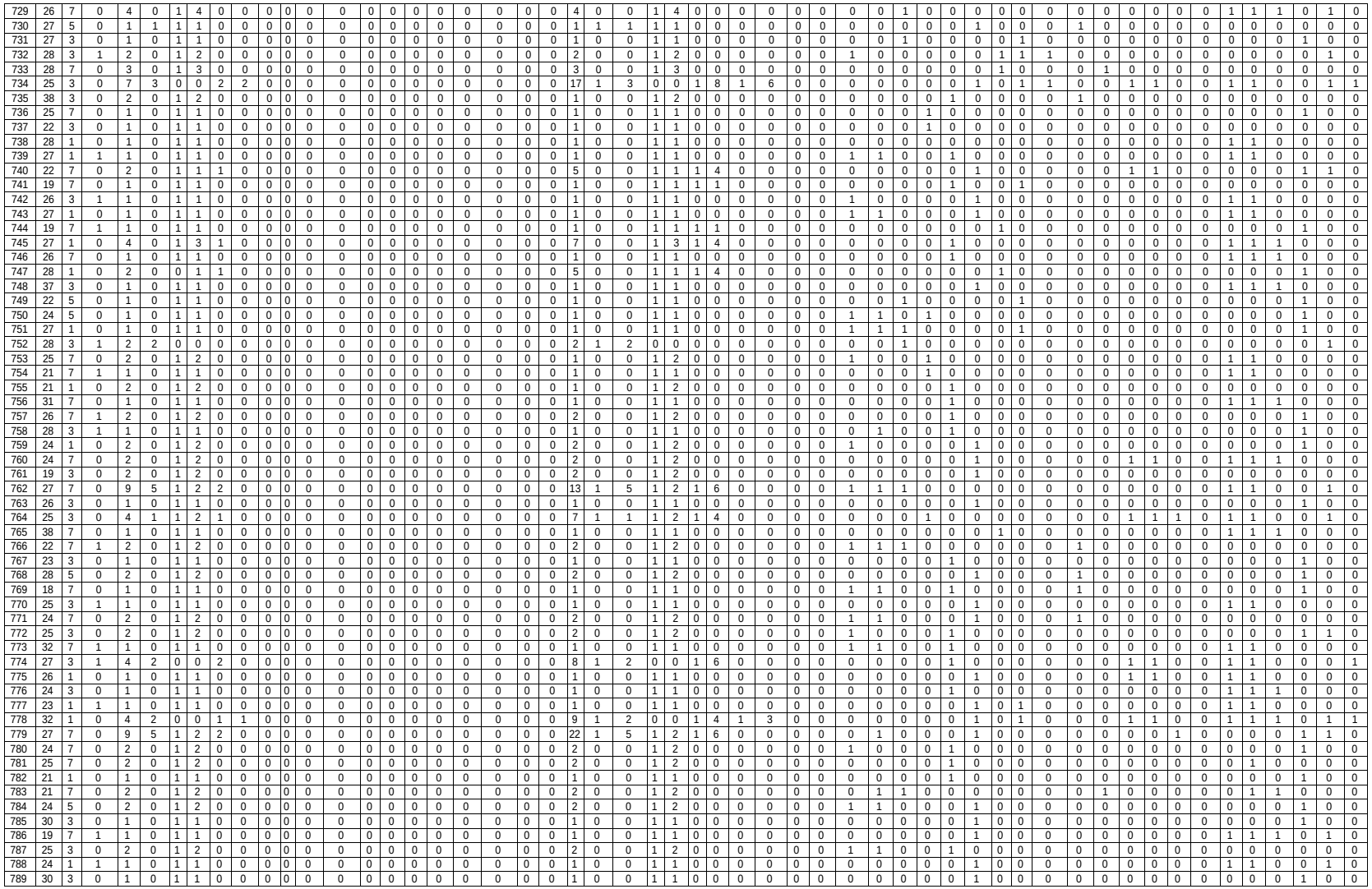

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917	25	7	0	4	0	1	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	1	4	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0
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987	21	1	1	2	0	1	2	0	0	0	2	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0
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989	27	3	1	1	0	1	1	0	0	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	1	1	0	0	0	0	0	0
990	23	3	0	1	0	1	1	0	0	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
991	19	7	1	1	0	1	1	0	0	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
992	25	7	0	1	0	1	1	0	0	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0
993	22	2	0	4	0	1	3	1	0	0	1	0	0	1	3	1	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
994	23	4	0	1	0	1	1	0	0	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	1	1	1	0	0	0	0
995	24	7	0	1	0	1	1	0	0	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
996	24	1	0	1	0	1	1	0	0	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0
997	24	4	0	1	0	1	1	0	0	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
998	23	6	0	1	0	1	1	0	0	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
999	30	7	0	1	0	1	1	0	0	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0
1000	24	3	0	1	0	1	1	0	0	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0
1001	29	3	0	3	2	0	0	0	0	0	3	1	2	0	0	1	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0
1002	19	3	1	1	0	1	1	0	0	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0
1003	29	3	0	1	0	1	1	0	0	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0
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1005	24	4	0	4	0	1	1	1	0	0	2	0	0	1	1	1	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1006	18	3	0	1	0	1	1	0	0	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1007	26	7	0	2	0	1	1	1	0	0	2	0	0	1	1	1	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0
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1009	24	1	0	3	0	1	1	0	2	0	3	0	0	1	1	0	0	1	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
1010	20	1	1	1	0	1	1	0	0	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0